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FLOOD INSURANCE STUDY

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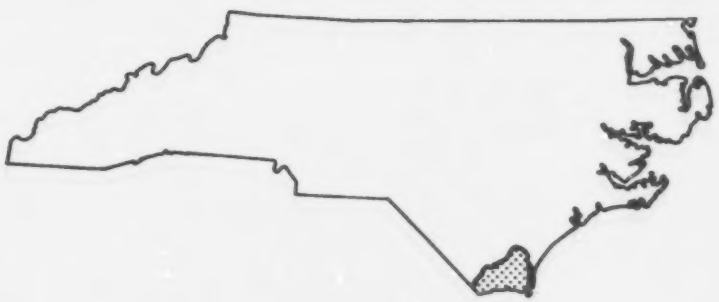
BRUNSWICK COUNTY, NORTH CAROLINA

UNINCORPORATED AREAS



MAY 15, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 370295

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Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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FLOOD INSURANCE STUDY

BRUNSWICK COUNTY,
UNINCORPORATED AREAS,
NORTH CAROLINA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Unincorporated Areas of Brunswick County, North Carolina, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Moore, Gardner & Associates, Inc. (the Study Contractor) for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-C-0272. This study was completed in October 1982.

The execution of the Coastal Flooding Storm Surge Model was performed by Tetra Tech, Inc., of Pasadena, California, under subcontract from Moore, Gardner & Associates, Inc. All field survey for the study was collected by Moore, Gardner & Associates, Inc.

1.3 Coordination

A search for basic data was made at all levels of government. Local interests were informed of the initiation of the study and were requested to furnish available pertinent information. Information was also requested from the North Carolina Department of Natural Resources and Community Development, the U.S. Army Corps of Engineers (COE), the U.S. Soil Conservation Service, the Agricultural Stabilization Conservation Service, the U.S. Geological Survey (USGS), and the National Oceanic and Atmospheric Administration (NOAA). The USGS furnished "Map of Flood Prone Areas" for the county (Reference 1). Flood Hazard Boundary Maps of the county were obtained from the FEMA (Reference 2).

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A meeting was held in Bolivia, North Carolina, with FEMA and local interests on June 13, 1979, to inform the community of the nature and purpose of the Flood Insurance Study, to solicit community input, and to identify and discuss areas requiring detailed study.

On January 22, 1985, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Brunswick County, North Carolina. The area of study is shown on the Vicinity Map (Figure 1). The incorporated areas within the county were excluded from this study.

The study analysis includes coastline flooding due to hurricane-induced storm surge. Both the open coast surge and its inland propagation were studied; in addition, the added effects of wave heights were also considered.

The coastline of the county was included in a detailed study of storm surge. The following streams were also studied by detailed methods: Calabash Creek, the Calabash River, Indian Creek/Cherry Tree Prong, Jackeys Creek, the Lockwoods Folly River/Pinch Gut Creek, Lookout Creek, Mallory Creek, Mallory Creek Tributary, Mill Creek, Mulberry Branch, Shallotte Creek, Shallotte Creek Tributary, the Shallotte River, Sharron Creek, Sturgeon Creek, and Town Creek.

Approximate analyses were used to study those areas having a low development potential or minimum flood hazards.

The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through October 1987. The scope and methods of study were proposed to and agreed upon by FEMA and Brunswick County.

2.2 Community Description

Brunswick County is the southernmost county in North Carolina. It is bounded on the south by the Atlantic Ocean, on the west by Columbus County, North Carolina, and Horry County, South Carolina, on the north by Columbus and Pender Counties, North Carolina, and on the east by New Hanover County, North Carolina, and the Atlantic Ocean. The eastern boundary between Brunswick and New Hanover Counties predominantly follows the Cape Fear River.

The 1970 population of Brunswick County was 24,223 increasing to 35,777 by 1980 (Reference 3). Leading industries in the county are manufacturing, tourism, transportation, and commercial fishing. In 1979, Brunswick County was the second largest seafood producing county in North Carolina. Agriculture is a supporting industry in the county with tobacco being the leading crop (Reference 4).

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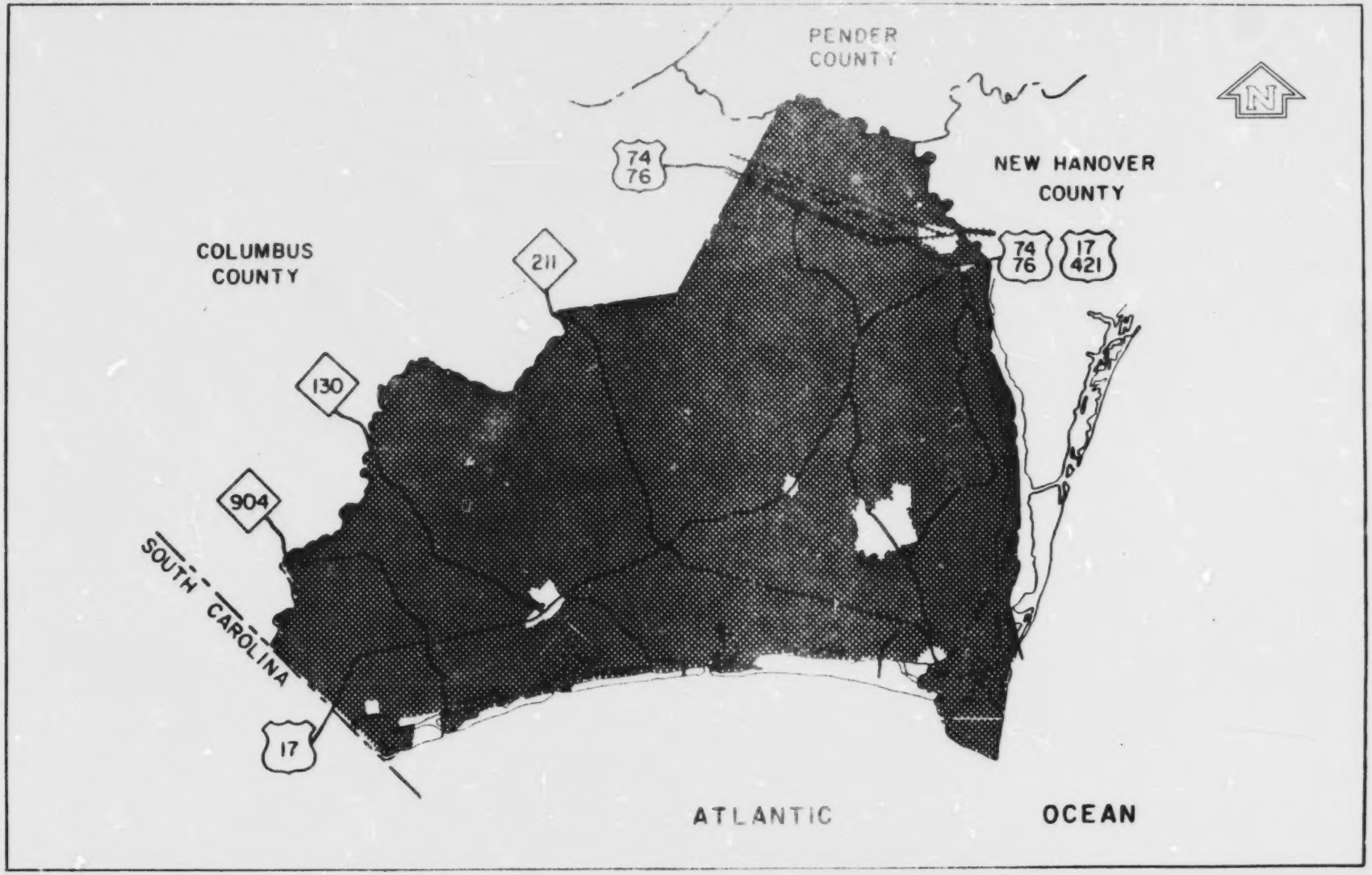

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

APPROXIMATE SCALE

8 0 8 16 24 MILES

VICINITY MAP

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The county has many natural and historic areas. The natural areas contain many rare species of plants and animals, including the American Alligator. Several natural areas are Big Cypress Bay, Big Island Savannah, and Piver's Bay Bog. The historic areas include Orton Plantation, an example of Southern antebellum architecture; Brunswick Town, a port town on the Cape Fear River prior to the Revolutionary War; and Bald Head Lighthouse, the oldest lighthouse still standing on the North Carolina shores.

Sunny Point Army Terminal is located in Brunswick County on the west side of the Cape Fear River. Oak Island Coast Guard Station also is located in the county near the east end of the barrier islands and is bounded on the east and west by the Town of Caswell Beach.

The terrain of the county consists of gentle slopes of less than 12 percent. Soil types present include Baymeade-Blanton-Kureb-Wando Association, Onslow-Goddsboro-Lynchburg Association, Leaf-Lenoir-Craven Association, Mandarin-Leon-Murville Association, Croatan-Murville-Leon-Mandarin Association, Muckalee-Lumbee-Dorovan Association, Marsh Association, and Coastal Beach-Dune Sand (Reference 4).

The climate of the county is moderate. Temperatures range from a monthly average of 47.7 degrees Fahrenheit (°F) in February to 79.9 °F in July. The yearly mean temperature is 64 °F. The mean annual precipitation is 50.85 inches (Reference 5).

There are 558,720 acres in Brunswick County, 52 percent of which are in use. In 1980, residential use accounted for 9,654 acres; commercial, 838 acres; industrial, 5,143 acres; government, 9,400 acres; recreation, 639 acres; agriculture, 37,087 acres; forest, 22,834 acres; and undeveloped and water, 269, 195 acres.

2.3 Principal Flood Problems

In the past, Brunswick County has been subjected to numerous tropical storms and hurricanes that have caused extensive damage due to the effects of high-water levels and wave action. These storms occur most frequently during the summer and early fall.

One of the most destructive hurricanes to affect Brunswick County was Hurricane Hazel, which hit the coast at approximately the North Carolina - South Carolina line on October 15, 1954. As was reported by the Raleigh Water Bureau:

> . . . Wind-driven tides devastated the immediate oceanfront from the South Carolina line to Cape Lookout. All traces of civilization on that portion of the immediate waterfront between the state line and Cape Fear were practically annihilated. Grass-covered dunes, some 10 to 20 feet high along and behind which beach homes had been built in a continuous line five miles long, simply disappeared, dunes, houses and all. The paved roadway along which the houses were built was partially washed away, partially buried beneath several feet of sand. The greater part of the material from which the houses had been built was washed from one to two

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> hundred yards back into the edge of the low-lying woods which cover the leeward side of the islands. Some of this material is identifiable as having been parts of houses, but the greater portion of it is ground to unrecognizable splinters and bits of masonry. Of the 357 buildings which existed on Long Beach, 352 were totally destroyed and the other five damaged. Similar conditions prevail on Holden Beach, Ocean Isle, Robinson Beach and Colonial Beach. (Robinson Beach and Colonial Beach are now part of Holden Beach.) In most cases it is impossible to tell where the buildings stood. Where grassy dunes stood, there is now only flat, white, sandy beach . . . (Reference 6).

The COE reported:

> . . . Apart from the loss of life and the property damages suffered by individuals, the most striking aspect of the storm's effects on Brunswick County shores was the absolute totality of the damage. . . In this connection, there was hardly a vestige of human habitation on the Brunswick County shore following the storm. . . (Reference 7).

Other severe storms to have effected Brunswick County were hurricanes of 1874, 1881, 1883, and 1955. Partly due to the county's east-west orientation, northeasters are not a major source of flooding (Reference 7).

2.4 Flood Protection Measures

Flood protection measures do not exist within the study area.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

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3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community. Analyses were also carried out to establish the peak elevation-frequency relationships for each coastal flooding source studied in detail.

A method developed by the USGS that establishes peak discharge-frequency relationships for selected flood frequencies was used to determine discharges. This method is described in USGS publication number 76-17 (Reference 8). For 257 gage sites in North Carolina, the magnitudes of floods having recurrence intervals of from 2 to 100 years were provided in tables. For ungaged sites, multiple regression techniques were used to define the relation between flood peak discharge and seven basin and climatic variables including drainage area, channel slope, channel length, storage, soil, precipitation, and rainfall intensity. From the results of preliminary regression analysis, the state was divided into two sections -- Coastal Plain section and Mountain and Piedmont section. Through additional analyses, statistical equations were developed for each geographic area. In the publication, equations, graphs, and maps were presented for the estimation of flood magnitudes at ungaged sites. None of the detailed study streams in Brunswick County have gaging stations.

The 500-year equation for the USGS method was developed by extrapolating the curves on graphs that related recurrence interval to equation coefficients and exponents.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each riverine flooding source studied in detail in the community are shown in Table 1.

Tidal frequency-elevation relationships were determined for the waters surrounding Brunswick County by analyzing peak storm surges combined with tide elevations. Extensive research was conducted to determine typical storm characteristics of those tropical storms and hurricanes affecting Brunswick County. The storm parameters analyzed were central pressure, radius of maximum winds, forward speed, direction of travel, and point of landfall or distance offshore if parallel to the coast. Probabilistic values of these parameters were determined and are presented in Table 2. Combinations of these parameters were used in the Coastal Flooding Storm Surge Model (Reference 9) to produce hurricane storm surge histories, each of which has an associated probability dependent on the values of the parameters involved. The peak surges for each history were added to tide elevations, each with an associated probability, and the results were analyzed to determine the 10-, 50-, 100-, and 500-year stillwater flood elevations.

As wave action in addition to high water is also of concern, a wave analysis was completed. The determination of maximum wave crest elevations associated with the 10- and 100-year events was approached by the method recommended by the National Academy of Sciences (Reference 10). Further details are included in Section 3.3 of this study.

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TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CALABASH CREEK					
at confluence with the Calabash River (below dam)	0.76	75	300	530	920
above lake	0.23	80	200	280	520
CALABASH RIVER					
at confluence with the Little River	12.42	850	1,750	2,260	3,460
at NC 179	9.11	710	1,480	1,920	2,990
about 1,000 feet downstream of confluence of Calabash Creek	7.76	640	1,360	1,770	2,770
below dam	6.74	590	1,260	1,650	2,590
INDIAN CREEK/CHERRY TREE PRONG					
at confluence with the Cape Fear River	11.58	810	1,690	2,180	3,340
about 14,000 feet upstream of mouth	9.51	720	1,520	1,970	3,050
at NC SR 1453	7.03	600	1,280	1,680	2,640
at NC SR 1426	1.65	250	590	790	1,330
about 2,000 feet upstream of NC SR 1426	1.07	200	460	630	1,080
JACKEYS CREEK					
at confluence with the Brunswick River	10.25	760	1,580	2,050	3,160
about 7,700 feet upstream of confluence with the Brunswick River	9.11	710	1,480	1,920	2,990
about 11,000 feet upstream of confluence with the Brunswick River	8.82	690	1,450	1,890	2,940
about 16,000 feet upstream of confluence	6.87	600	1,270	1,660	2,610
at US 17	3.76	420	910	1,210	1,960
about 3,000 feet upstream of US 17	2.30	310	700	940	1,560
about 5,000 feet upstream of US 17	1.63	250	580	790	1,320

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TABLE 1 - SUMMARY OF DISCHARGES (continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LOCKWOODS FOLLY RIVER/PINCH GUT CREEK					
about 13,000 feet upstream from confluence with Atlantic Ocean	129.92	3,440	6,330	7,660	10,490
about 18,000 feet upstream of confluence	117.40	3,240	5,990	7,270	10,000
about 29,000 feet upstream of confluence	111.72	3,140	5,830	7,090	9,770
about 53,000 feet upstream of confluence	104.06	3,010	5,610	6,830	9,450
at NC 211	97.16	2,890	5,400	6,590	9,150
about 6,000 feet upstream of NC 211	66.25	2,300	4,380	5,400	7,630
about 11,000 feet upstream of NC 211	65.48	2,280	4,350	5,370	7,590
at NC SR 1501	52.15	2,000	3,840	4,770	6,810
about 11,500 feet upstream of NC SR 1501	48.89	1,920	3,710	4,610	6,610
at US 17	17.04	1,020	2,080	2,660	4,010
about 5,500 feet upstream of US 17	15.08	950	1,950	2,500	3,790
about 8,000 feet upstream of US 17	11.92	830	1,710	2,210	3,390
at NC SR 1401	5.70	530	1,150	1,510	2,390
about 5,000 feet upstream of NC SR 1401	4.40	460	990	1,320	2,120
at Rouark Road	2.64	340	750	1,010	1,660
LOOKOUT CREEK					
at confluence with the Shallotte River	3.08	370	820	1,090	1,790
about 6,500 feet upstream of confluence	2.83	350	780	1,050	1,720
at NC 130	2.33	310	700	900	1,570
about 2,000 feet upstream of NC 130	0.86	170	410	560	980

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TABLE 1 - SUMMARY OF DISCHARGES (continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
MALLORY CREEK					
at confluence with the Cape Fear River	8.47	680	1,420	1,850	2,880
about 4,000 feet upstream of confluence	5.83	540	1,160	1,530	2,420
at NC 133	5.06	500	1,070	1,420	2,260
about 2,500 feet upstream of NC 133	4.51	460	1,010	1,340	2,140
about 5,500 feet upstream of NC 133	2.51	330	730	980	1,620
at Wire Road	1.82	270	610	830	1,390
at Wire Spur	0.42	110	280	390	700
MALLORY CREEK TRIBUTARY					
at confluence with Mallory Creek	1.10	200	470	640	1,100
about 4,000 feet upstream of confluence	0.64	140	350	480	850
at Wire Road	0.16	60	160	240	440
MILL CREEK					
at confluence with the Lockwoods Folly River	11.86	830	1,710	2,210	3,380
about 4,000 feet upstream of confluence	11.67	820	1,690	2,190	3,360
at NC SR 1112	11.22	800	1,660	2,140	3,290
about 5,000 feet upstream of NC SR 1112	10.21	750	1,580	2,040	3,150
MULBERRY BRANCH					
at confluence with the Shallotte River	5.15	500	1,080	1,430	2,280
at NC SR 1439	4.69	470	1,030	1,360	2,180
about 2,000 feet upstream of NC SR 1439	4.30	450	980	1,300	2,090

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TABLE 1 - SUMMARY OF DISCHARGES (continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
at NC SR 1348	2.67	340	760	1,020	1,700
about 1,500 feet upstream of NC SR 1439	2.29	310	700	940	1,550
SHALLOTTE CREEK					
at confluence with the Shallotte River	13.02	870	1,800	2,320	3,540
about 10,000 feet upstream of confluence	10.62	770	1,610	2,090	3,210
about 17,500 feet upstream of confluence	6.30	570	1,210	1,590	2,510
about 23,000 feet upstream of confluence	3.14	370	830	1,110	1,800
at NC 130	1.95	280	640	860	1,440
about 7,500 feet upstream of NC 130	1.21	210	490	670	1,150
SHALLOTTE CREEK TRIBUTARY					
at confluence with Shallotte Creek	3.65	410	900	1,200	1,940
at NC SR 1141	1.68	260	590	800	1,340
at NC 130	1.06	200	460	630	1,080
about 3,500 feet upstream of NC 130	0.43	110	280	390	700
SHALLOTTE RIVER					
about 10,000 feet upstream of confluence with Atlantic Ocean	65.56	1,930	3,730	4,640	6,640
about 18,500 feet upstream of confluence	44.60	1,820	3,530	4,400	6,330
about 23,000 feet upstream of confluence	43.66	1,800	3,490	4,350	6,270
about 27,000 feet upstream of confluence	34.76	1,570	3,080	3,860	5,620

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TABLE 1 - SUMMARY OF DISCHARGES (continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
at US 17	32.28	1,500	2,950	3,710	5,430
at NC 130	26.68	1,340	2,660	3,360	4,960
at private road	23.34	1,240	2,480	3,140	4,660
at 2,000 feet upstream of private road	22.42	1,210	2,420	3,070	4,570
SHARRON CREEK					
at confluence with the Shallotte River	8.35	670	1,410	1,840	2,870
at NC SR 1134	7.48	630	1,310	1,740	2,720
about 3,500 feet upstream of NC SR 1134	3.10	370	820	1,100	1,790
STURGEON CREEK					
at confluence with the Brunswick River	14.85	940	1,930	2,480	3,760
at NC SR 1472	7.70	640	1,350	1,760	2,700
at US 74 and 76	5.09	500	1,080	1,420	2,270
about 3,000 feet upstream of US 74 and 76	3.55	400	880	1,180	1,910
at NC SR 1438	1.11	200	470	640	1,100
TOWN CREEK					
about 9,500 feet downstream of US 17	57.46	2,110	4,050	5,010	7,130
about 6,000 feet downstream of US 17	55.27	2,070	3,970	4,910	7,000
at US 17	54.84	2,060	3,950	4,890	6,980
about 3,000 feet upstream of US 17	54.50	2,050	3,940	4,880	6,960
about 6,000 feet upstream of US 17	54.04	2,040	3,920	4,860	6,930
about 10,500 feet upstream of US 17	53.03	2,020	3,880	4,810	6,870

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CENTRAL PRESSURE DEPRESSION (Millibars)	5	15	25	35	45	55	65	75	85
PROBABILITY:									
ENTERING	.132	.132	.132	.144	.162	.160	.084	.042	.012
EXITING	0	0	0	0	0	0	0	0	0
PARALLEL	.238	.238	.238	.143	.050	.050	.026	.013	.004
STORM RADIUS (Nautical Miles)			20				35		
PROBABILITY			.51				.49		
FORWARD SPEED (Knots)			10		20		30		
PROBABILITY:									
ENTERING			.626		.278		.096		
EXITING			0		0		0		
PARALLEL			.463		.370		.167		
CROSSING ANGLE[1] (Degrees)	-144		-108		-72		-36		0
PROBABILITY	.033		.041		.089		.398		.439
FREQUENCY OF OCCURRENCE	$0.18(10^{-3})$		$0.19(10^{-3})$		$0.41(10^{-3})$		$2.17(10^{-3})$		$1.94(10^{-3})$

1 Degrees clockwise from North

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

PARAMETER VALUES FOR SURGE ELEVATION COMPUTATIONS

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the riverine sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross-section data for the streams in the study area were obtained by field survey. All bridges, dams, and culverts were field checked to obtain elevation data and structural geometry. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map.

Channel roughness factors (Manning's "n") used in the hydraulic computations, were chosen using engineering judgment, and were based on field observations of the streams and floodplain areas (Reference 11). Roughness values ranged from 0.025 to 0.12 for the main channels of streams and 0.025 to 0.150 for the overbank areas.

Water-surface elevations of floods of the selected recurrence intervals were computed through use of the HEC-2 computer program (Reference 12). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Starting water-surface elevations for streams in the study area were calculated using the slope-area method described in the HEC-2 manual. All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly Mean Sea Level of 1929. Elevation reference marks used in this study are shown and described on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Coastal flood elevations were estimated from the Coastal Flooding Storm Surge Model (Reference 9). This model accounts for the driving forces of surface wind stress and atmospheric pressure gradients, the retarding force of bottom friction, and the inertia forces of convective and coriolis accelerations. The equations are solved by an explicit, finite-difference numerical method. Inputs to the model consist of topographic information of the coastal area, ocean depths, windfield data, roughness coefficients, and hurricane characteristics. Ocean bathymetric information was obtained from NOAA nautical charts (Reference 13) and land elevations were obtained from field surveys, from topographic maps compiled by the COE (Reference 14), and from USGS quadrangles (Reference 15). Hurricane parameter values were obtained in part from the National Climatic Center Tropical Cyclone Deck 993 (Reference 16). The outputs of the model are hurricane surge histories from which the peak surge of each history was used for further calculations. Tide elevations were added to the peak to obtain stillwater flood elevations. The computed stillwater flood elevations for Brunswick County are tabulated in the Coastal Flood Insurance Zone Data, Table 5 (see Section 5.2).

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3.3 Wave Height Analysis

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in a report prepared by the National Academy of Sciences (Reference 10). This method is based on the following major concepts. First, depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest is 70 percent of the total wave height above the stillwater level. The second major concept is that wave height may be diminished by dissipation of energy due to the presence of obstructions, such as sand dunes, dikes and seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed in Reference 10. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

Wave heights were computed along transects (cross-section lines) that were located along the coastal areas, as illustrated in Figure 2, Transect Location Map, in accordance with the "Users Manual for Wave Height Analysis" (Reference 17). The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced at large intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

The transects were continued inland until the wave was dissipated or until flooding from another source with equal or greater elevation was reached. Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevations, vegetation and physical features. The stillwater elevations for the 100-year flood were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. Areas with a wave component 3-feet or greater were designated as velocity zones. Other areas subject to wave action were designated as A zones with base flood elevations adjusted to include wave crest elevations.

Figure 3 is a profile for a hypothetical transect showing the effects of energy dissipation on a wave as it moves inland. This figure shows the wave elevations being diminished by obstructions, such as buildings, vegetation, and rising ground elevations and being increased by open, unobstructed wind fetches. Actual wave conditions in Brunswick County may not necessarily include all the situations illustrated in Figure 3.

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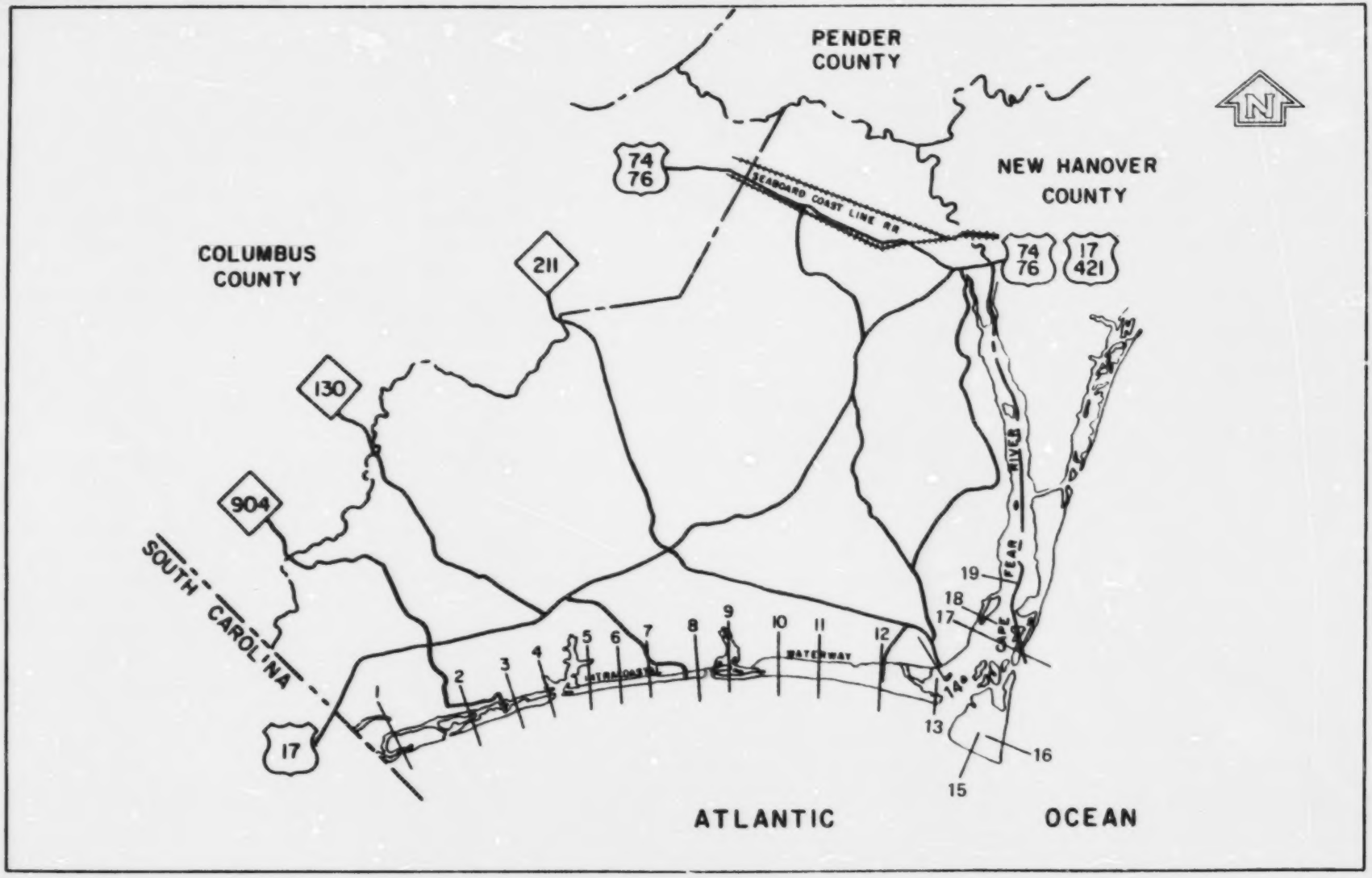

FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

APPROXIMATE SCALE

8 0 8 16 24 MILES

TRANSECT LOCATION MAP

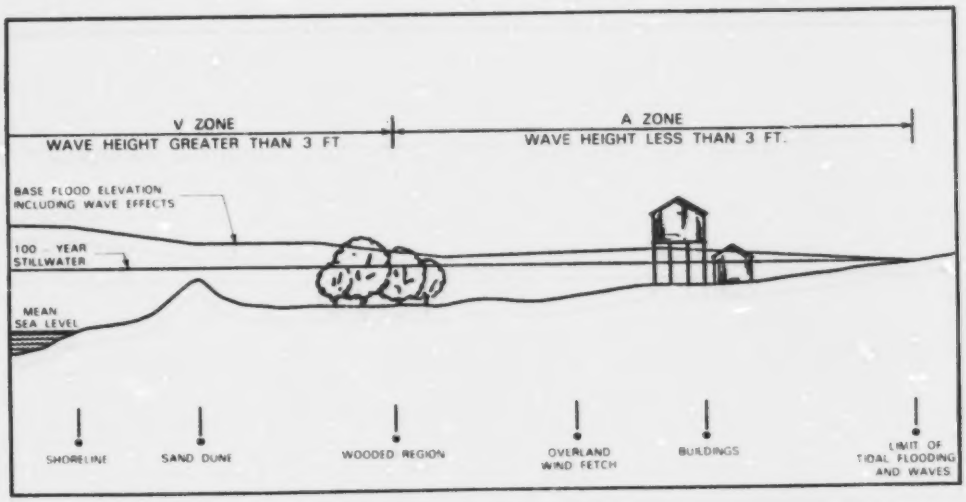

FIGURE 3 - Transect Schematic

To obtain technical data for the wave height analysis, topographic data was obtained from field surveyed transects, shown on Figure 2, from the COE maps of Brunswick County beaches (Reference 14) and from USGS quadrangles (Reference 15). Ground cover and building spacing information were obtained from aerial photographs (Reference 18) and from field observation.

During severe storms, beach erosion is expected to occur along the ocean shoreline of Brunswick County. The methodology used to determine the effects of storm-induced beach erosion is described in a report by North Carolina State University (Reference 19). The methodology is based on the concept that a beach profile that is in dynamic equilibrium under normal weather conditions will approach a new equilibrium under elevated storm surge and waves. The new equilibrium profile is determined by first calculating the area offshore over which material eroded from the beach and dune is deposited and then adjusting the onshore erosion profile such that its area equals the area of deposition offshore. A "pivot point," which is the point along the original profile where the ground elevation is minus two feet mean sea level, separates the areas of deposition and erosion. The deposition area is determined by reducing the offshore slope from the pivot point to the limit of breaking waves by a factor of two and computing the area contained between the existing and revised profiles. In like manner, the erosional area is calculated by reducing the profile slopes from the pivot point inland by a factor of two and computing the area between the two profiles until the cumulative area of eroded material equals the area of material deposited offshore.

The methodology described in Reference 19 is strictly applicable only when the dune is initially higher than the storm surge and remains so over the duration of the storm. For the majority of cases in Brunswick County, the

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dunes are initially overtopped by the 100-year surge. Dunes that are initially higher than the surge but are overtopped during the storm are also encountered. In these cases, a modification to the methodology described in Reference 19 was employed. Specifically, the concept of a balance between onshore erosion and offshore deposition was retained. However, erosion now extends to the backside of the dune, whereas before, erosion was confined to the foreshore side of the dune. The original profile slope was reduced by a factor of two along the front face of the dune. However, along the backside of the dune, a slope reduction by a factor of two was not strictly adhered to; the slope of the eroded profile varied until an area balance was reached. In cases where the eroded area would not equal the deposition area before the first street running parallel to the coast was reached, the profile was terminated at the street. It was assumed that the street would not wash out during the storm.

The first row of houses along the shore was located in the erosion zone and subject to a wave of three feet or greater. These buildings were considered ineffectual in damping waves. A computer routine was used to apply the methodologies to modify existing beach profiles before wave analyses were performed.

Computed wave elevations are based on existing topography, vegetation, and current development patterns and will require recomputation if significant changes occur in any of the above factors.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing floodplain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps of Brunswick County at a scale of 1:12000, with contour intervals of 5, 10, and 20 feet (Reference 15). For each coastal flooding source studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each transect. Between transects, the boundaries were interpolated using the above-mentioned topographic maps (Reference 15).

For the streams studied by approximate methods, only the 100-year floodplain boundary was delineated using the Flood Hazard Boundary Maps above-mentioned topographic maps (References 2 and 15).

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Floodplain boundaries are indicated on the Flood Insurance Rate Map. On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zone A, numbered A zones, and numbered V zones) and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards (Zone B). In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the floodplain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed and are presented in Table 3, Floodway Data.

As shown on the Flood Boundary and Floodway Map, the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and the 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe thus encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT[3] FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
CALABASH RIVER								
A	8850	459/209[2]	678	2.8	12.8	2.0	2.0	0.0
B	9150	461/341[2]	709	2.7	12.8	2.2	2.2	0.0
C	11,575	527/307[2]	1617	1.2	12.8	3.1	3.1	0.0
D	15,575	223/163[2]	389	4.5	12.8	4.2	4.2	0.0
E	17,050	283/213[2]	1232	1.3	12.8	5.1	5.9	0.8
F	17,350	449/349[2]	2166	0.8	12.8	6.3	6.4	0.1
G	21,800	181/131[2]	679	2.4	12.8	6.9	7.2	0.3
CALABASH CREEK								
A	325	50	72	7.4	12.7	3.0	4.0	1.0
B	625	416	3727	0.1	12.7	11.3	11.8	0.5
C	2085	199	1417	0.2	12.7	11.3	11.8	0.5
D	2385	162	948	0.3	12.7	11.3	11.9	0.6

[1]FEET ABOVE MOUTH
[2]TOTAL WIDTH/WIDTH WITHIN UNINCORPORATED AREA
[3]ELEVATIONS COMPUTED WITHOUT CONSIDERING COASTAL SURGE FROM ATLANTIC OCEAN

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

FLOODWAY DATA

CALABASH RIVER—CALABASH CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
LOCKWOODS FOLLY RIVER								
A	21,950	150	1329	5.4	11.2	2.7[3]	3.0	0.3
B	29,450	645	3821	1.9	10.9	5.2[3]	6.1	0.9
C	39,075	1268	7623	0.9	10.4	5.9[3]	6.8	0.9
D	47,050	1260	6926	1.0	10.2	6.3[3]	7.3	1.0
E	52,900	433	3431	2.0	10.1	7.1[3]	8.1	1.0
F	56,625	700	5203	1.3	9.9	7.9[3]	8.9	1.0
G	63,150	435	4520	1.5	9.7	8.9[3]	9.9	1.0
H	63,375	1000	7229	0.9	9.6	9.0[3]	10.0	1.0
I	68,975	1980	15,686	0.3	9.4	9.4	10.4	1.0
J	74,350	1000	8167	0.7	9.6	9.6	10.6	1.0
K	86,700	933	8541	0.6	10.9	10.9	11.9	1.0
L	91,625	1456	11,656	0.5	11.6	11.6	12.5	0.9
M	92,020	1280	8792	0.5	11.7	11.7	12.6	0.9
N	98,050	1330	7206	0.7	13.1	13.1	13.7	0.6
O	101,575	1129	7455	0.6	14.3	14.3	14.6	0.3
P	109,725	974	2928	0.9	17.0	17.0	17.0	0.0
Q	109,950	598	2970	0.9	18.0	18.0	18.1	0.1
R	115,300	896	4263	0.6	19.6	19.6	20.0	0.4
S	116,500	597	1673	1.5	20.4	20.4	20.9	0.5
T	117,725	407	1830	1.2	23.2	23.2	23.8	0.6
PINCH GUT CREEK								
U	120,950[2]	383	1495	1.5	25.9	25.9	26.5	0.6
V	124,175[2]	222	1114	1.4	32.5	32.5	33.2	0.7

[1]FEET ABOVE MOUTH
[2]FEET ABOVE MOUTH OF LOCKWOODS FOLLY RIVER
[3]ELEVATIONS COMPUTED WITHOUT CONSIDERING COASTAL SURGE FROM ATLANTIC OCEAN

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

FLOODWAY DATA

LOCKWOODS FOLLY RIVER—PINCH GUT CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
PINCH GUT CREEK								
W	124,400	250	1426	1.1	33.6	33.6	34.0	0.4
X	126,700	149	679	2.2	36.4	36.4	37.3	0.9
Y	129,025	230	1186	1.1	41.2	41.2	42.0	0.8
Z	130,425	167	763	1.7	43.4	43.4	44.2	0.8
AA	131,825	172	567	1.8	47.9	47.9	48.7	0.8
AB	132,000	493	1451	0.7	49.0	49.0	49.3	0.3
SHALLOTTE RIVER								
A	10,125[2]	1866	6259	0.7	12.4	0.2[4]	1.2	1.0
B	13,550[2]	1689	5014	0.9	12.0	1.0[4]	1.5	0.5
C	18,725[2]	322	2627	1.7	12.0	1.8[4]	2.2	0.4
D	23,300[2]	322	1515	2.9	11.8	2.4[4]	2.9	0.5
E	27,275[2]	172	1277	3.0	11.5	4.8[4]	5.6	0.8
F	38,397[2]	575/385[3]	4167	0.8	11.4	9.5[4]	10.4	0.9
G	38,576[2]	631/291[3]	4743	0.7	11.4	10.0[4]	10.9	0.9
H	41,957[2]	888	6619	0.5	11.4	10.3[4]	11.2	0.9
I	42,125[2]	921	7472	0.4	11.3	11.3	12.1	0.8
J	45,867[2]	100	721	4.4	11.7	11.7	12.6	0.9
K	46,001[2]	313	1873	1.7	12.2	12.2	12.9	0.7
L	48,275[2]	750	3908	0.8	13.4	13.4	14.2	0.8

[1]FEET ABOVE MOUTH OF LOCKWOODS FOLLY RIVER
[2]FEET ABOVE MOUTH
[3]TOTAL WIDTH/WIDTH WITHIN UNINCORPORATED AREAS
[4]ELEVATIONS COMPUTED WITHOUT CONSIDERING COASTAL SURGE FROM ATLANTIC OCEAN

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

FLOODWAY DATA

PINCH GUT CREEK—SHALLOTTE RIVER

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
SHALLOTTE CREEK								
A	725	223	1148	2.0	12.2	1.4[2]	2.4	1.0
B	5000	595	2334	1.0	12.2	2.1[2]	2.9	0.8
C	10,350	172	394	5.3	12.2	3.7[2]	3.7	0.0
D	17,750	397	1821	0.9	12.2	5.3[2]	6.3	1.0
E	23,100	318	1234	0.9	12.2	6.3[2]	7.3	1.0
F	27,525	63	129	6.7	19.7	19.7	19.8	0.1
G	27,800	139	994	0.9	25.1	25.1	25.1	0.0
H	32,300	50	103	6.5	32.8	32.8	33.8	1.0
SHALLOTTE CREEK TRIBUTARY								
A	900	147	495	2.4	12.1	4.1[2]	5.1	1.0
B	1250	399	1866	0.6	12.1	6.3[2]	6.3	0.0
C	5800	50	72	11.1	12.1	8.8[2]	8.8	0.0
D	6150	279	1761	0.5	15.6	15.6	16.1	0.5
E	9775	50	69	9.1	17.6	17.6	17.7	0.1
F	10,000	208	1019	0.6	22.0	22.0	22.6	0.6
G	13,850	50	71	5.5	28.2	28.2	28.5	0.3
H	14,925	749	704	0.6	28.8	28.8	29.8	1.0

[1]FEET ABOVE MOUTH
[2]ELEVATIONS COMPUTED WITHOUT CONSIDERING COASTAL SURGE FROM ATLANTIC OCEAN

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

FLOODWAY DATA

SHALLOTTE CREEK—SHALLOTTE CREEK TRIBUTARY

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
INDIAN CREEK								
A	13,925	261	1166	1.7	8.3	4.0[3]	4.4	0.4
B	17,090	65	394	4.3	8.3	6.3[3]	7.2	0.9
C	17,300	327	2017	0.9	10.5	10.5	10.5	0.0
D	18,100	355	2643	0.6	10.7	10.7	10.7	0.0
CHERRY TREE PRONG								
E	22,125	50	94	8.4	13.1	13.1	13.6	0.5
F	22,400	306	3509	0.3	27.0	27.0	27.0	0.0
G	24,600	325	1555	0.5	27.0	27.0	27.0	0.0
H	27,000	50	91	7.0	27.0	27.0	27.0	0.0
JACKEYS CREEK								
A	1100[2]	261	587	3.5	9.6	2.9[3]	3.9	1.0
B	1250[2]	493	1832	1.1	9.6	5.7[3]	5.8	0.1
C	7775[2]	794	3639	0.5	9.6	6.4[3]	6.8	0.4
D	11,400[2]	870	4304	0.4	9.6	6.6[3]	7.2	0.6
E	16,325[2]	508	1607	1.0	9.6	7.8[3]	8.6	0.8
F	22,750[2]	174	1065	1.1	14.6	14.6	15.0	0.4
G	23,050[2]	274	2313	0.5	17.9	17.9	18.0	0.1
H	25,925[2]	208	564	1.7	18.5	18.5	18.9	0.4
I	28,075[2]	402	1308	0.6	21.6	21.6	22.6	1.0

[1]FEET ABOVE MOUTH OF INDIAN CREEK
[2]FEET ABOVE MOUTH
[3]ELEVATIONS COMPUTED WITHOUT CONSIDERING COASTAL SURGE FROM ATLANTIC OCEAN

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

FLOODWAY DATA

INDIAN CREEK—CHERRY TREE PRONG—JACKEYS CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
LOOKOUT CREEK								
A	750	125	658	1.7	11.4	7.2[2]	8.2	1.0
B	3600	196	834	1.3	13.1	12.7[2]	13.6	0.9
C	6700	178	623	1.7	20.2	20.2	21.0	0.8
D	9075	87	333	2.9	32.5	32.5	33.4	0.9
E	9300	166	933	1.0	36.0	36.0	37.0	1.0
F	10,100	161	853	0.7	36.5	36.5	37.5	1.0
G	10,700	164	916	0.6	36.7	36.7	37.7	1.0
MALLORY CREEK								
A	0	120	634	2.9	9.6	0.3[2]	1.3	1.0
B	3725	829	1460	1.0	9.6	2.9[2]	3.7	0.8
C	7000	412	1502	0.9	9.6	4.8[2]	5.6	0.8
D	7200	668	3154	0.5	9.6	6.8[2]	7.2	0.4
E	12,450	324	838	1.2	9.6	9.6	10.5	0.9
F	15,525	504	1978	0.4	11.6	11.6	12.4	0.8
G	15,725	484	1619	0.5	12.1	12.1	12.6	0.5
H	20,500	86	94	4.2	18.1	18.1	18.9	0.8
I	20,700	147	391	1.0	21.5	21.5	21.8	0.3

[1]FEET ABOVE MOUTH
[2]ELEVATIONS COMPUTED WITHOUT CONSIDERING COASTAL SURGE FROM ATLANTIC OCEAN

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC
(UNINCORPORATED AREAS)

FLOODWAY DATA

LOOKOUT CREEK—MALLORY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
MALLORY CREEK TRIBUTARY								
A	550	499	1527	0.4	9.8	8.4[2]	9.4	1.0
B	4000	121	382	1.3	10.9	10.9	11.6	0.7
C	5525	92	273	1.8	16.8	16.8	17.4	0.6
D	5750	50	174	2.8	19.5	19.5	19.5	0.0
E	7150	306	723	0.3	19.8	19.8	20.4	0.6
F	7350	320	680	0.4	22.9	22.9	23.1	0.2
MILL CREEK								
A	4275	274	896	2.4	11.8	4.0[2]	4.7	0.7
B	7900	675	2923	0.7	11.8	4.4[2]	5.2	0.8
C	13,325	929	5236	0.4	11.8	4.9[2]	5.6	0.7
SHARRON CREEK								
A	2525	50	302	6.1	11.4	2.6[2]	3.6	1.0
B	8190	171	791	2.2	11.4	7.9[2]	8.7	0.8
C	8440	256	1425	1.2	11.4	8.4[2]	9.3	0.9
D	12,000	183	1069	1.0	11.4	8.9[2]	9.8	0.9

[1]FEET ABOVE MOUTH
[2]ELEVATIONS COMPUTED WITHOUT CONSIDERING COASTAL SURGE FROM ATLANTIC OCEAN

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC
(UNINCORPORATED AREAS)

FLOODWAY DATA

MALLORY CREEK TRIBUTARY—MILL CREEK—SHARRON CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
STURGEON CREEK								
A	2950	250/200[2]	1411	1.8	9.4	7.9[3]	8.9	1.0
B	3800	325/275[2]	3248	0.8	9.4	8.0[3]	9.0	1.0
C	4100	331/231[2]	3279	0.8	9.4	8.0[3]	9.0	1.0
D	9275	633	5160	0.3	9.4	8.1[3]	9.1	1.0
E	9650	533	3056	0.6	9.4	8.3[3]	9.3	1.0
F	15,700	200	1724	1.0	9.4	9.2[3]	10.1	0.9
G	16,200	697	6174	0.3	14.0	14.0	14.9	0.9
H	16,825	797	6347	0.2	14.0	14.0	14.9	0.9
I	17,035	706	5031	0.3	14.2	14.2	15.2	1.0
J	20,325	196	996	1.2	14.5	14.5	15.5	1.0
K	24,625	157	163	3.8	24.8	24.8	24.9	0.1
L	24,825	50	299	2.1	30.4	30.4	30.4	0.0
TOWN CREEK								
A	101,675	69	580	8.5	10.0	2.6[3]	2.6	0.0
B	107,748	119	1700	2.9	10.0	7.3[3]	7.5	0.2
C	108,100	119	1479	3.3	10.0	7.4[3]	7.7	0.3
D	111,150	302	2823	1.7	10.0	8.1[3]	8.7	0.6
E	114,250	2392	15,532	0.3	10.0	8.4[3]	9.1	0.7
F	118,650	2418	17,634	0.3	10.0	8.7[3]	9.3	0.6

[1]FEET ABOVE MOUTH
[2]TOTAL WIDTH/WIDTH WITHIN UNINCORPORATED AREAS
[3]ELEVATIONS COMPUTED WITHOUT CONSIDERING COASTAL SURGE FROM ATLANTIC OCEAN

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

FLOODWAY DATA

STURGEON CREEK—TOWN CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
MULBERRY BRANCH								
A	800	320/250[2]	937	1.5	11.4	4.0[3]	5.0	1.0
B	5075	51/41[2]	266	5.1	11.4	8.9[3]	9.4	0.5
C	5275	124/94[2]	897	1.5	11.4	11.4	12.1	0.7
D	6950	322/112[2]	1975	0.7	12.2	12.2	12.9	0.7
E	10,675	207	231	4.8	16.5	16.5	16.5	0.0
F	10,850	238	1612	0.6	19.6	19.6	20.2	0.6
G	12,275	217	1024	0.9	20.0	20.0	20.7	0.7

[1]FEET ABOVE MOUTH
[2]TOTAL WIDTH/WIDTH WITHIN UNINCORPORATED AREAS
[3]ELEVATIONS COMPUTED WITHOUT CONSIDERING COASTAL SURGE FROM ATLANTIC OCEAN

BEST COPY AVAILABLE

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

FLOODWAY DATA

MULBERRY BRANCH

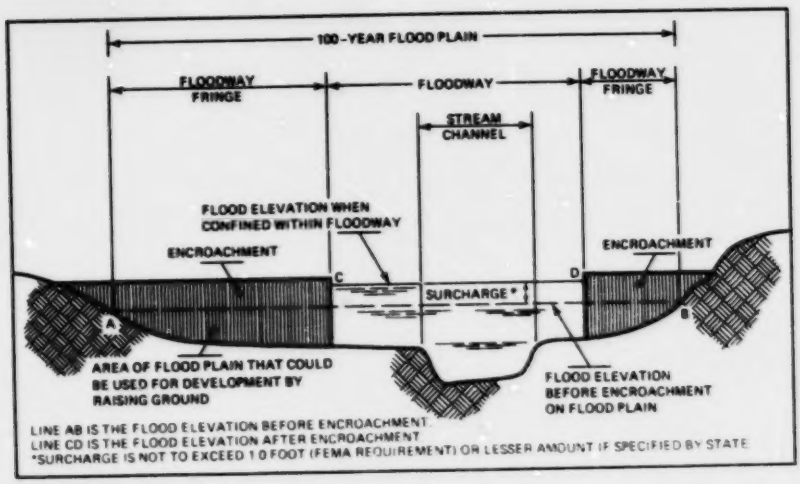
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FIGURE 4 - Floodway Schematic

The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

4.3 Base Flood Elevations

Areas within the community studied by detailed engineering methods have base flood elevations established in A and V zones. These are the elevations of the base (100-year) flood relative to NGVD. In coastal areas affected by wave action, base flood elevations are generally maximum at the normal open shoreline. These elevations generally decrease in a landward direction at a rate dependent on the presence of obstructions capable of dissipating the wave energy. Where possible, changes in base flood elevations have been shown in 1-foot increments on the Flood Insurance Rate Map. However, where the scale did not permit, 2- or 3-foot increments were sometimes used. Base flood elevations shown in the wave action areas represent the average elevation within the zone. These elevations vary from 12 to 20 feet NGVD in Brunswick County and are shown on the Flood Insurance Rate Map. Current program regulations generally require that all new construction be elevated such that the first floor, including basement, is above the base flood elevation in A and V zones.

4.4 Velocity Zones

The COE (Reference 20) has established the 3-foot wave as the criterion for identifying coastal high hazard zones. This was based on a study of wave action effects on structures. This criterion has been adopted by FEMA for the determination of V zones. Because of the additional hazards associated with high-energy waves, the National Flood Insurance Program regulations require much more stringent floodplain management measures in these areas, such as elevating structures on piles or piers. In addition, insurance rates in V zones are higher than those in A zones with similar numerical designations.

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The location of the V zones is determined by the 3-foot wave as discussed previously. The detailed analysis of wave heights performed in this study allowed a much more accurate location of the V zone to be established. The V zone generally extends inland to the point where the 100-year flood depth is insufficient to support a 3-foot wave.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting Brunswick County.

5.1 Reach Determinations

For riverine studies, reaches are defined as sections of floodplain that have relatively the same flood hazard, based on the weighted average difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the riverine flooding sources of Brunswick County are shown on the Flood Profiles and summarized in Table 4, Flood Insurance Zone Data.

In coastal areas, reaches are limited to the distance for which the 100-year flood elevation does not vary more than 1.0 foot. The location of these reaches are shown on the Flood Insurance Rate Map.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a riverine reach is the weighted average difference between the 10- and 100-year flood water-surface elevations rounded to the nearest 0.5 foot, multiplied by 10, and shown as a 3-digit code.

The FHF for areas subject only to storm surge flooding is the difference between the 10- and 100-year stillwater elevations rounded to the nearest 0.5 foot, multiplied by 10, and shown as a 3-digit code. For areas with wave heights less than 3 feet, the FHF is the weighted average difference between the 100-year wave crest elevation and the 10-year stillwater elevation. For areas with wave heights greater than 3 feet, the FHF is

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determined using the difference between the 10- and 100-year stillwater elevations multiplied by 1.55, then rounded to the nearest 0.5 foot, multiplied by 10, and shown as a 3-digit code.

For example, if the difference between elevations is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.
Zones A2-A7, A9-A14, A16:	Special Flood Hazard Areas inundated by the 100-year flood, with base flood elevations shown, and zones subdivided according to FHFs.
Zones V10-V14, V16, V17:	Special Flood Hazard Areas along coasts inundated by the 100-year flood that have additional velocity hazards associated with waves of 3-foot amplitude or greater, with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- and 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and, areas subject to 100-year flooding from sources with drainage areas of less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are shown in Table 4, Flood Insurance Zone Data, and Table 5, Coastal Flood Insurance Zone Data.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (FEET NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
INDIAN CREEK							
REACH 1	0040	−3.50	−1.20	4.68	035	A7	VARIES—SEE MAP
CHERRY TREE PRONG							
REACH 1	0040	−1.75	−0.63	3.38	020	A4	VARIES—SEE MAP
REACH 2	0040	−8.09	−3.57	13.51	080	A16	27
REACH 3	0040	−3.73	−2.93	17.28	035	A7	27
JACKEYS CREEK							
REACH 1	0130	−2.14	−0.85	2.16	020	A4	VARIES—SEE MAP
LOOKOUT CREEK							
REACH 1	0195,0215	−1.45	−0.47	0.94	015	A3	VARIES—SEE MAP
MALLORY CREEK							
REACH 1	0130,0140	−1.20	−0.26	0.64	010	A2	VARIES—SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

INDIAN CREEK—CHERRY TREE PRONG—JACKEYS CREEK—LOOKOUT CREEK—MALLORY CREEK

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (FEET NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
LOCKWOODS FOLLY RIVER							
REACH 1	0220,0230,0240	−2.48	−0.65	1.17	025	A5	VARIES--SEE MAP
PINCH GUT CREEK							
REACH 1	0230	−2.48	−0.65	1.17	025	A5	VARIES--SEE MAP
SHALLOTTE RIVER							
REACH 1	0330	−3.28	−1.08	1.58	035	A7	VARIES--SEE MAP
SHALLOTTE CREEK							
REACH 1	0335	−1.55	−0.51	0.86	015	A3	VARIES--SEE MAP
SHALLOTTE CREEK TRIBUTARY							
REACH 1	0335	−2.16	−0.78	1.08	020	A4	VARIES--SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

LOCKWOODS FOLLY RIVER--PINCH GUT CREEK--SHALLOTTE RIVER--SHALLOTTE CREEK --SHALLOTTE CREEK TRIBUTARY

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (FEET NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
MALLORY CREEK TRIBUTARY							
REACH 1	0130	−1.07	−0.34	0.75	010	A2	VARIES—SEE MAP
STURGEON CREEK							
REACH 1	0130	−5.20	−2.50	7.87	050	A10	VARIES—SEE MAP
REACH 2	0130	−2.03	−0.61	5.21	020	A4	VARIES—SEE MAP
MULBERRY BRANCH							
REACH 1	0215	−2.24	−0.83	1.13	020	A4	VARIES—SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

MALLORY CREEK TRIBUTARY—STURGEON CREEK—MULBERRY BRANCH

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FLOODING SOURCE[1]	FLOOD INSURANCE RATE MAP PANEL	TRANSECT	STILLWATER ELEVATION (FEET NGVD)				FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[2] (FEET NGVD)
			10-YEAR	50-YEAR	100-YEAR	500-YEAR			
ATLANTIC OCEAN	0315	1	7.40	11.09	12.65	15.90	080 065	V16 A13	15–18 13–14
	0320	2	7.38	11.10	12.70	16.04	085[3] 065	V17 A13	15–16 13–15
	0330,0320,0310	3	7.36	11.11	12.73	16.10	065	A13	13–14
	0330	4	7.36	11.12	12.74	16.16	065[3]	A13	14–15
	0330	5	7.20	11.04	12.68	16.16	085	V17	15
	0330,0335	6	7.25	10.99	12.63	16.12	070[3]	A14	13–14
	0335	7	7.13	10.85	12.51	16.08	070[3]	A14	13–14
	0355	8	7.16	10.88	12.51	16.10	070[3]	A14	13
	0355	9	6.93	10.78	12.47	15.96	085 060[3]	V17 A12	15–16 12–15
	0355	10	6.91	10.76	12.36	15.83	060[3]	A12	12
	0360	11	6.88	10.63	12.19	15.46	060[3]	A12	12–14
	0380	12	6.77	10.51	12.09	15.32	080[3] 060[3]	V16 A12	14 12–14

[1]COASTAL FLOODING EFFECTS FROM ATLANTIC OCEAN
[2]DUE TO MAP SCALE LIMITATIONS, BASE FLOOD ELEVATIONS (BFE'S) SHOWN ON THE FLOOD INSURANCE RATE MAP MAY REPRESENT AVERAGE ELEVATION FOR THE ZONE DEPICTED
[3]WEIGHTED AVERAGE VALUE

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

COASTAL FLOOD INSURANCE ZONE DATA

ATLANTIC OCEAN

FLOODING SOURCE[1]	FLOOD INSURANCE RATE MAP PANEL	TRANSECT	STILLWATER ELEVATION (FEET NGVD)				FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[2] (FEET NGVD)
			10-YEAR	50-YEAR	100-YEAR	500-YEAR			
ATLANTIC OCEAN	0380,0390	13	6.19	9.39	10.83	13.86	070 065[3]	V14 A13	14–17 11–12
	0380	14	5.92	9.55	11.14	14.48	065[3] 050	V13 A10	14 12–13
	0395	15	5.83	8.72	10.10	13.32	065	V13	16
	0390,0395	16	5.36	7.87	8.86	11.10	055 050[3]	V11 A10	11–14 9–11
	0385,0395	17	5.34	7.84	8.78	10.79	060[3] 055 050[3]	V12 V11 A10	12 11–14 10–11
	0385	18	5.72	8.20	9.11	11.03	050[3] 045	V10 A9	11–12 10
	0270	19	5.94	8.32	9.15	10.88	050 045[3]	V10 A9	11–12 10
	0145,0260,0270	N/A	6.6	9.0	10.0	11.6	035	A7	10
	0135,0140	N/A	6.6	8.8	9.7	11.1	030	A6	10
	0040,0045,0130,0135	N/A	6.5	8.7	9.4	10.8	030	A6	9

[1]COASTAL FLOODING EFFECTS FROM ATLANTIC OCEAN
[2]DUE TO MAP SCALE LIMITATIONS, BASE FLOOD ELEVATIONS (BFE'S) SHOWN ON THE FLOOD INSURANCE RATE MAP MAY REPRESENT AVERAGE ELEVATION FOR THE ZONE DEPICTED
[3]WEIGHTED AVERAGE VALUE

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

COASTAL FLOOD INSURANCE ZONE DATA

ATLANTIC OCEAN

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FLOODING SOURCE[1]	FLOOD INSURANCE RATE MAP PANEL	TRANSECT	STILLWATER ELEVATION (FEET NGVD)				FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[2] (FEET NGVD)
			10-YEAR	50-YEAR	100-YEAR	500-YEAR			
ATLANTIC OCEAN	0040,0045	N/A	6.4	8.1	8.7	10.0	025	A5	9
	0045	N/A	6.4	8.0	8.6	9.6	020	A4	9
	0040,0050	N/A	6.4	7.8	8.3	9.3	020	A4	8
CALABASH RIVER	0315	N/A	7.3	11.2	12.8	15.8	065[3]	A13	13
CALABASH CREEK	0315	N/A	7.3	11.2	12.7	15.8	065[3]	A13	13
CAPE FEAR RIVER	0145,0260,0270	N/A	6.6	9.0	10.0	11.6	035	A7	10
	0135,0145	N/A	6.6	8.8	9.7	11.1	030	A6	10
	0040,0045,0135	N/A	6.5	8.7	9.4	10.8	030	A6	9
	0040,0045,0135	N/A	6.4	8.1	8.7	10.0	025	A5	9
	0040,0045	N/A	6.4	8.0	8.6	9.6	020	A4	9
	0040,0050	N/A	6.4	7.8	8.3	9.3	020	A4	8
LOCKWOODS FOLLY RIVER	0220,0240,0335,0355	N/A	6.4-4.0	10.2-6.1	15.2-9.2	15.7-10.7	055[3]	A11	9–14
SHALLOTTE RIVER	0215,0330	N/A	7.3-6.7	10.6-10.0	12.3-11.4	16.0-13.9	050[3]	A10	11–12

[1]COASTAL FLOODING EFFECTS FROM ATLANTIC OCEAN
[2]DUE TO MAP SCALE LIMITATIONS, BASE FLOOD ELEVATIONS (BFE'S) SHOWN ON THE FLOOD INSURANCE RATE MAP REPRESENT AVERAGE ELEVATION FOR THE ZONE DEPICTED
[3]WEIGHTED AVERAGE VALUE

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

COASTAL FLOOD INSURANCE ZONE DATA

ATLANTIC OCEAN

FLOODING SOURCE[1]	FLOOD INSURANCE RATE MAP PANEL	TRANSECT	STILLWATER ELEVATION (FEET NGVD)				FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[2] (FEET NGVD)
			10-YEAR	50-YEAR	100-YEAR	500-YEAR			
SHALLOTTE CREEK	0330,0335	N/A	7.5-7.2	10.2-10.6	12.1	15.9	050[3]	A10	12
SHALLOTTE CREEK TRIBUTARY	0335	N/A	7.5	10.3	12.0	15.8	050[3]	A10	12
INDIAN CREEK	0040	N/A	6.4	7.0	8.4	9.5	020	A4	8
JACKEYS CREEK	0130,0135	N/A	6.6	8.8	9.6	10.8	030	A6	10
LOOKOUT CREEK	0215	N/A	6.8-7.5	10.2-11.7	11.5-13.1	14.0-16.2	050[3]	A10	12–13
MALLORY CREEK	0130,0135,0140,0145	N/A	6.6	8.9	9.7	11.3	030	A6	10
MALLORY CREEK TRIBUTARY	0130	N/A	6.6	8.9	9.7	11.3	030	A6	10
MILL CREEK	0355	N/A	6.3	10.2	14.0-11.9	15.7	055[3]	A11	12–14
SHARRON CREEK	0215	N/A	6.4	10.4	11.5	14.6	050	A10	11
STURGEON CREEK	0040,0045,0130	N/A	6.3	8.3	9.2	10.5	030	A6	9
TOWN CREEK	0120,0140,0145	N/A	6.6	9.0	10.0	11.6	035	A7	10
MULBERRY BRANCH	0215	N/A	6.6-7.2	10.1	11.4	14.0	050[3]	A10	11

[1]COASTAL FLOODING EFFECTS FROM ATLANTIC OCEAN
[2]DUE TO MAP SCALE LIMITATIONS, BASE FLOOD ELEVATIONS (BFE'S) SHOWN ON THE FLOOD INSURANCE RATE MAP MAY REPRESENT AVERAGE ELEVATION FOR THE ZONE DEPICTED
[3]WEIGHTED AVERAGE VALUE

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, NC

(UNINCORPORATED AREAS)

COASTAL FLOOD INSURANCE ZONE DATA

ATLANTIC OCEAN

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5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Brunswick County is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines for riverine flooding sources show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. For coastal flooding sources, the expected water-surface elevations of the base (100-year) flood are shown as a weighted average within zones. Each whole-foot elevation is delineated except where cartographic considerations require the combination of two or more elevation zones. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Flood Insurance Studies have been published for the Unincorporated Areas of Pender and New Hanover Counties, North Carolina, Horry County, South Carolina, the City of Southport, and the Towns of Shallotte, Caswell Beach, Yaupon Beach, Long Beach, Holden Beach, Ocean Isle Beach, and Sunset Beach, North Carolina (References 21-31). These studies are in agreement with this study.

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for Brunswick County (Reference 2).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, 1371 Peachtree Street, NE., Suite 736, Atlanta, Georgia 30309.

8.0 REFERENCES AND BIBLIOGRAPHY

1. U.S. Geological Survey, Map of Flood Prone Areas, Contour Intervals 5, 10, and 20 feet; 15 Minute Series: Acme, North Carolina, 1973; 7.5 Minute Series: Bolivia, North Carolina; Exum, North Carolina; Freeland, North Carolina; Funston, North Carolina; Honey Island, North Carolina; Juniper Creek, North Carolina; Lewis Swamp, North Carolina; Longs, South Carolina, North Carolina; Old Dock, North Carolina; Pireway, South Carolina, North Carolina; Southport, North Carolina; Supply, North Carolina; and Winnabow, North Carolina; 1973; Carolina Beach, North Carolina; Castle Hayne, North Carolina; Kure Beach, North Carolina; and Wilmington, North Carolina; 1974.

2. Federal Emergency Management Agency, Flood Hazard Boundary Map, Brunswick County, Unincorporated Areas, North Carolina, October 1983.

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25. ---------, Flood Insurance Study, Town of Shallotte, Unincorporated Areas, North Carolina, January 1986.

26. ---------, Flood Insurance Study, Town of Caswell Beach, Unincorporated Areas, North Carolina, January 1986.

27. ---------, Flood Insurance Study, Town of Yaupon Beach, Unincorporated Areas, North Carolina, December 1985.

28. ---------, Flood Insurance Study, Town of Long Beach, Unincorporated Areas, North Carolina, December 1985.

29. ---------, Flood Insurance Study, Town of Holden Beach, Unincorporated Areas, North Carolina, December 1985.

30. ---------, Flood Insurance Study, Town of Ocean Isle Beach, Unincorporated Areas, North Carolina, December 1985.

31. ---------, Flood Insurance Study, Town of Sunset Beach, Unincorporated Areas, North Carolina, December 1985.

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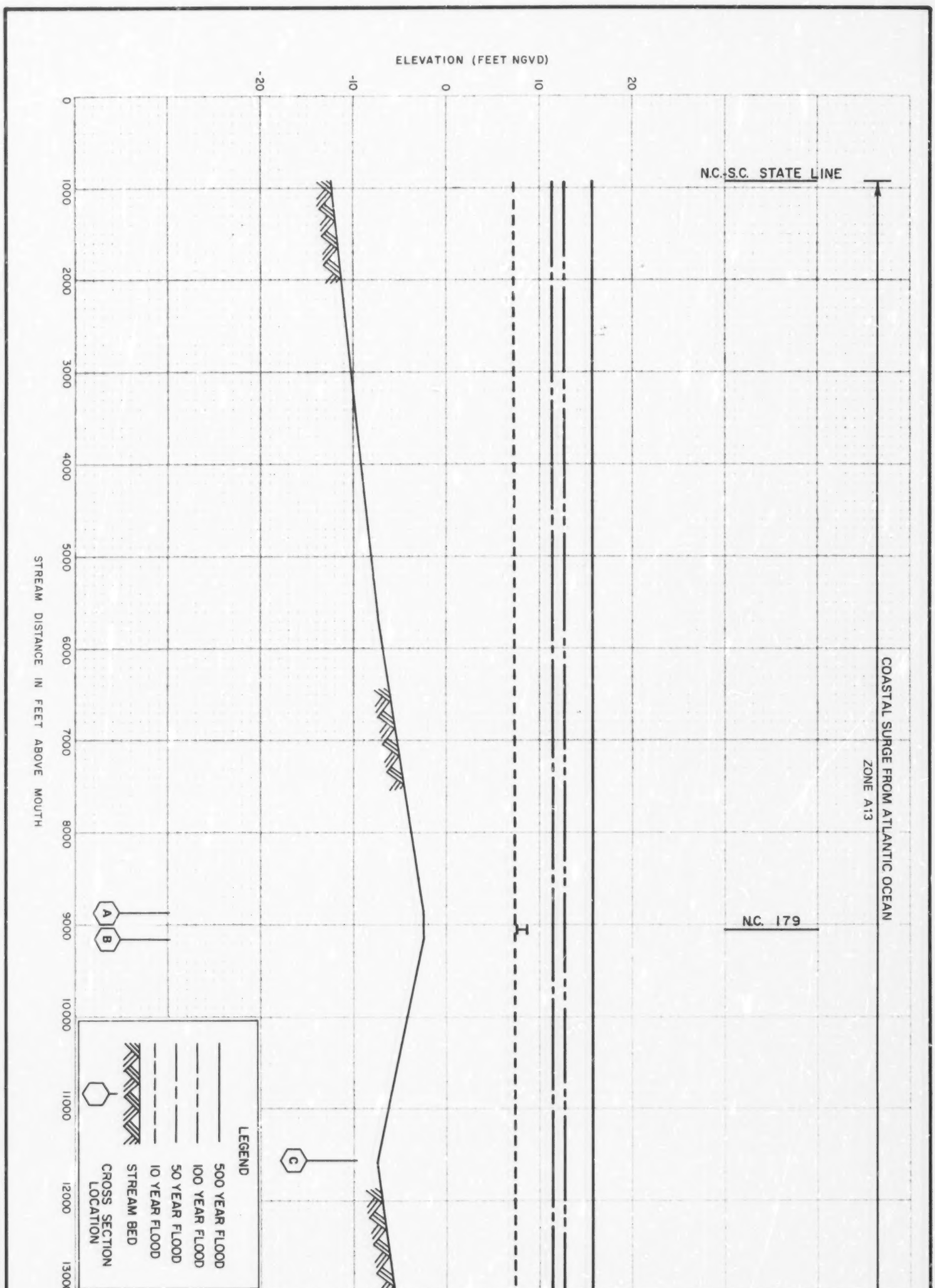

01P	FEDERAL EMERGENCY MANAGEMENT AGENCY BRUNSWICK COUNTY, N.C. (UNINCORPORATED AREA)	FLOOD PROFILES CALABASH RIVER

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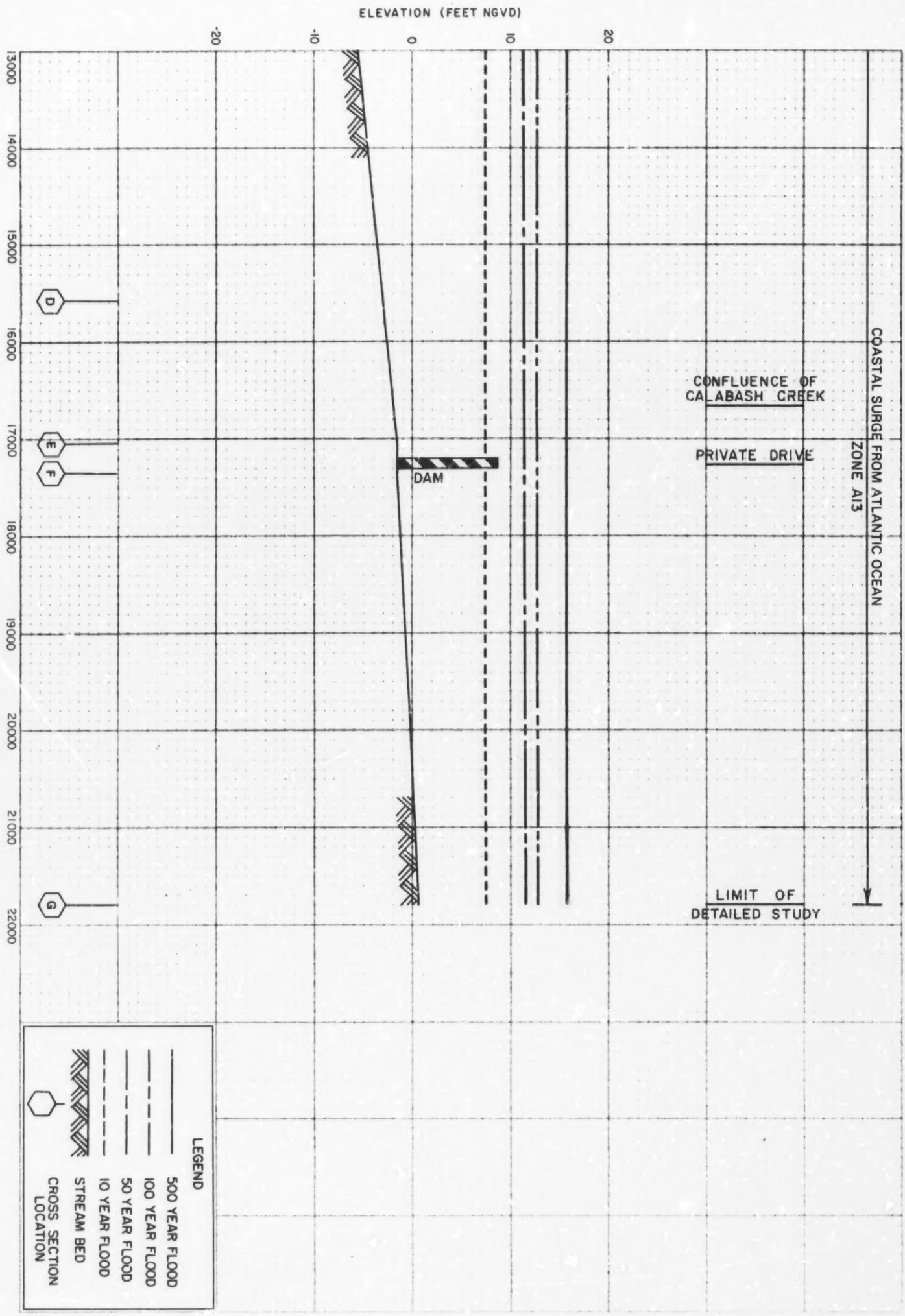

02P	FEDERAL EMERGENCY MANAGEMENT AGENCY BRUNSWICK COUNTY, N.C. (UNINCORPORATED AREA)	FLOOD PROFILES CALABASH RIVER

42

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FLOOD PROFILES

CALABASH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

03P

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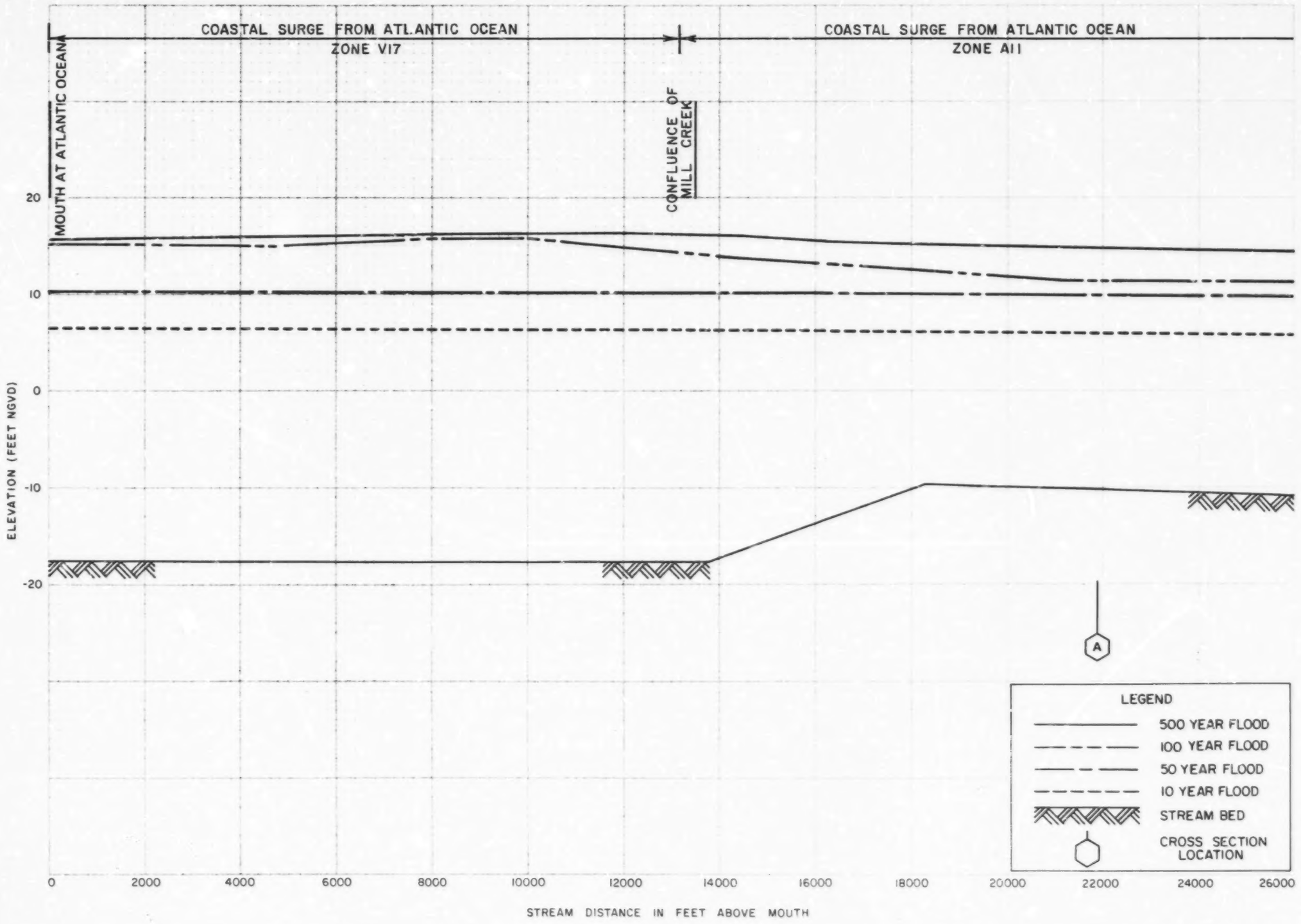

FLOOD PROFILES

LOCKWOODS FOLLY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

04P

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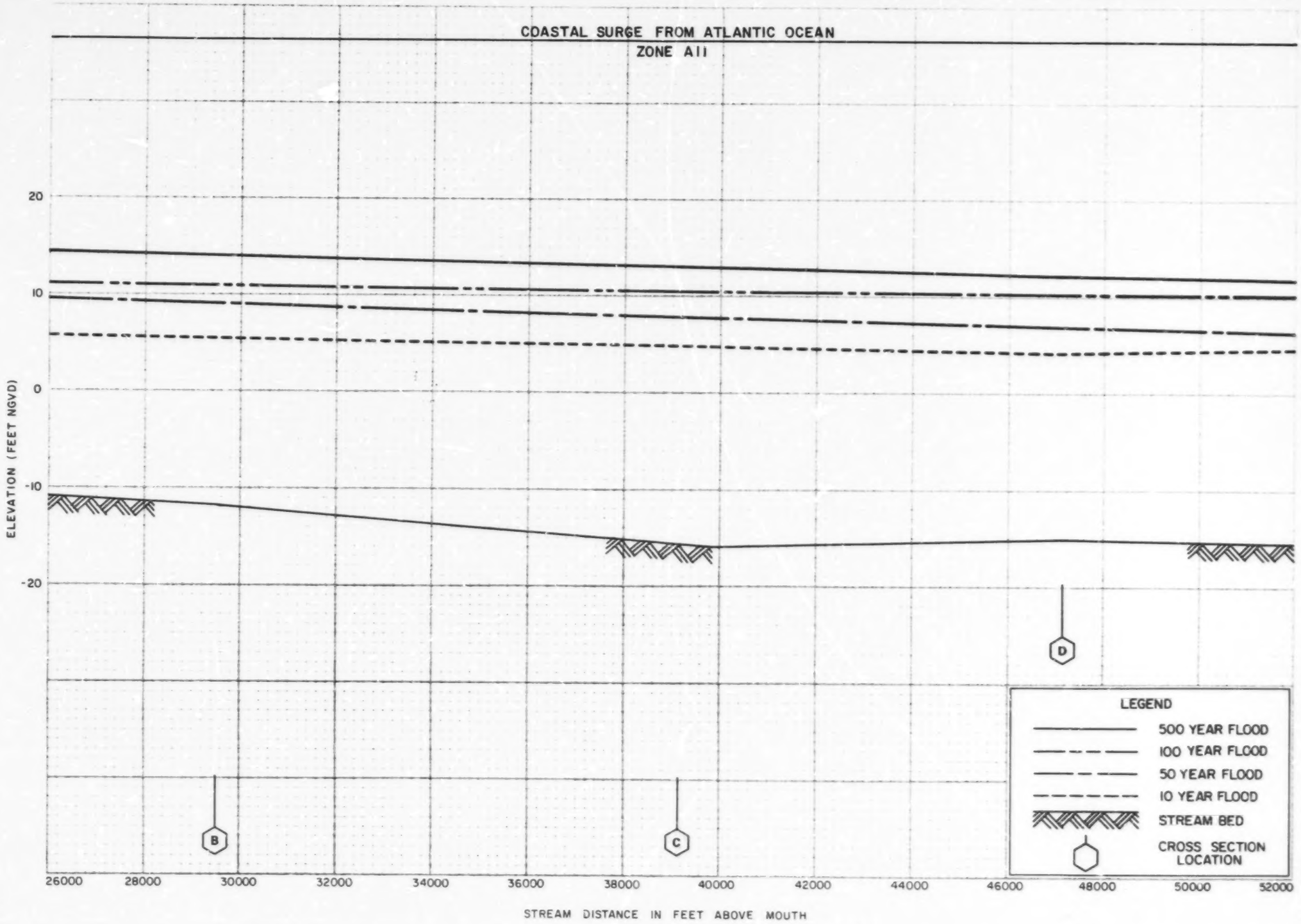
COASTAL SURGE FROM ATLANTIC OCEAN
ZONE A11



FLOOD PROFILES

LOCKWOODS FOLLY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
BRUNSWICK COUNTY, N.C.
(UNINCORPORATED AREA)

05P

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COASTAL SURGE FROM ATLANTIC OCEAN
ZONE A11

REACH 1
ZONE A5

N.C. 211

ELEVATION (FEET NGVD)

20
10
0
-10
-20

E
F
G
H
I
J

LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION

52000 54000 56000 58000 60000 62000 64000 66000 68000 70000 72000 74000 76000 78000

STREAM DISTANCE IN FEET ABOVE MOUTH

FLOOD PROFILES

LOCKWOODS FOLLY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
BRUNSWICK COUNTY, N.C.
(UNINCORPORATED AREA)

06P

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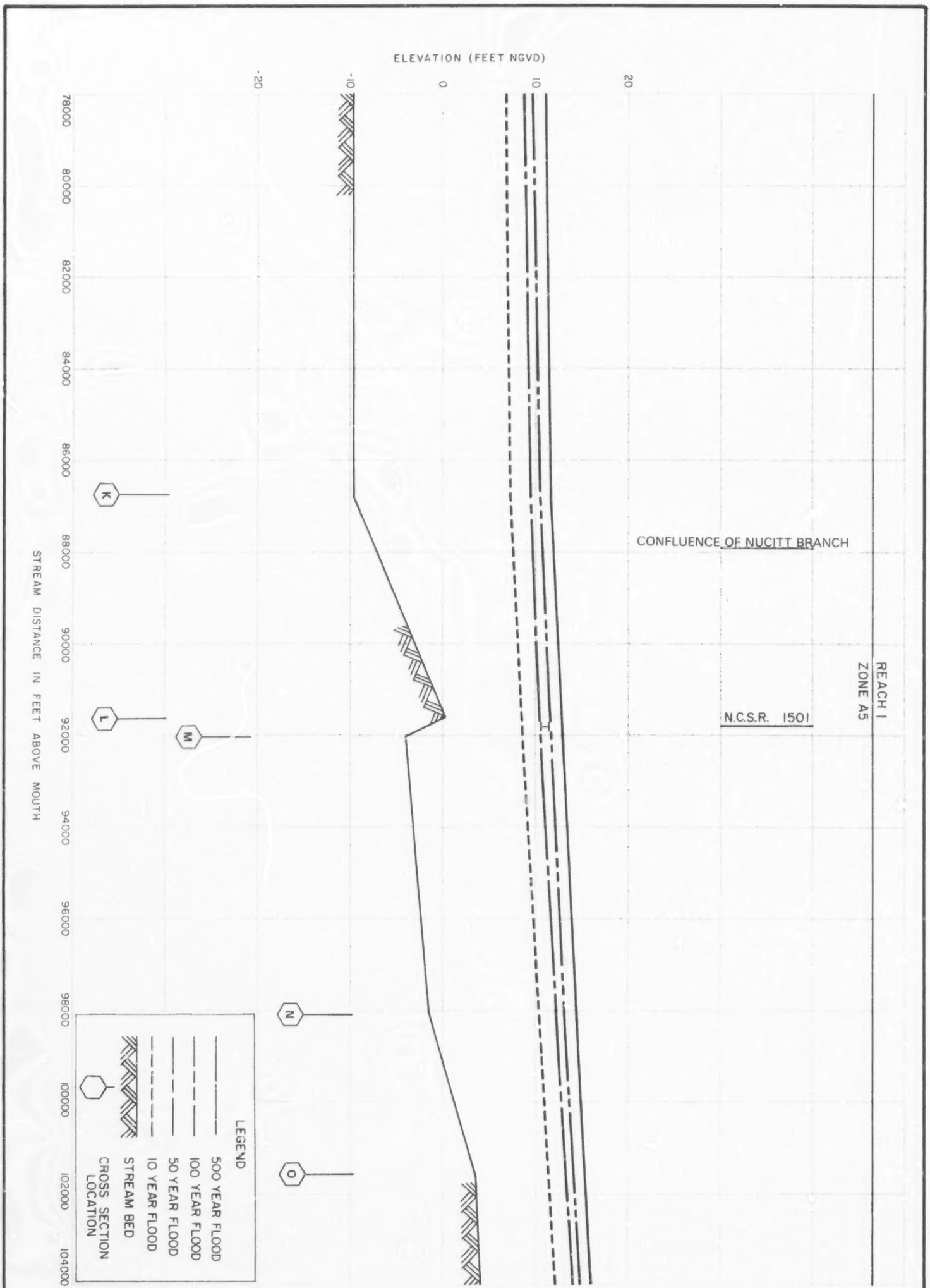

07P

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

FLOOD PROFILES

LOCKWOODS FOLLY RIVER

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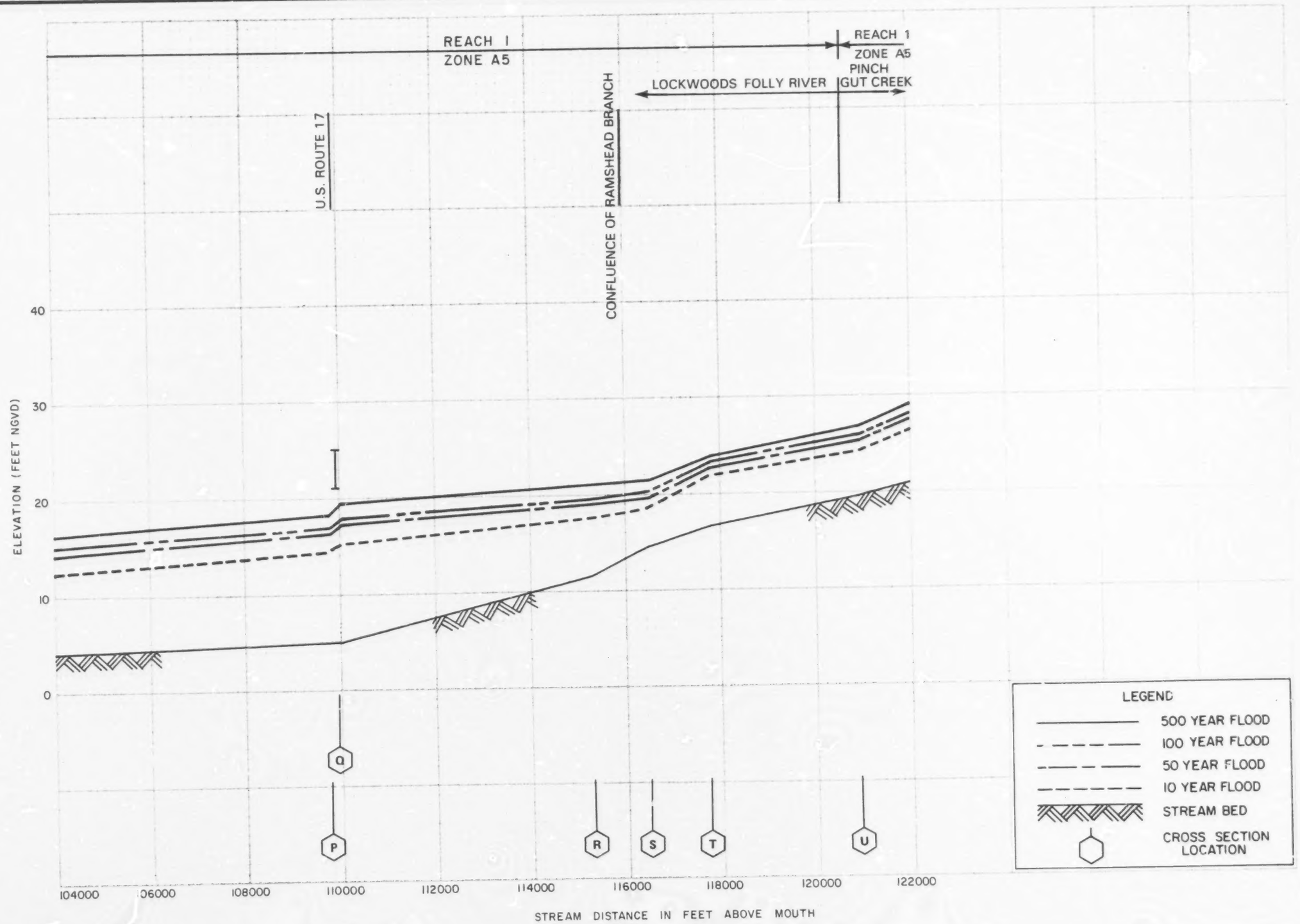

FLOOD PROFILES

LOCKWOODS FOLLY RIVER—PINCH GUT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
BRUNSWICK COUNTY, N.C.
(UNINCORPORATED AREA)

08P

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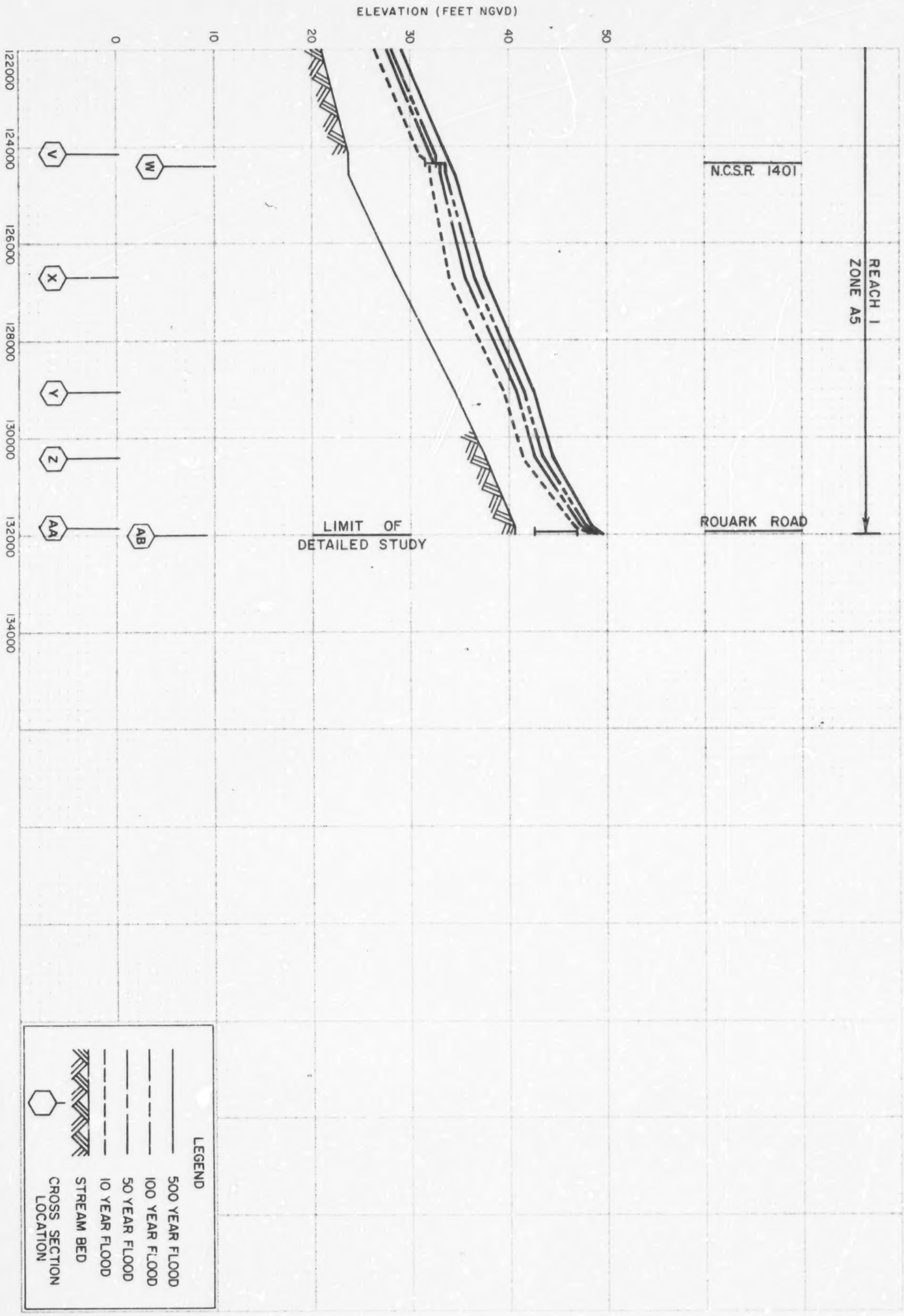

09P	FEDERAL EMERGENCY MANAGEMENT AGENCY BRUNSWICK COUNTY, N.C. (UNINCORPORATED AREA)	FLOOD PROFILES PINCH GUT CREEK

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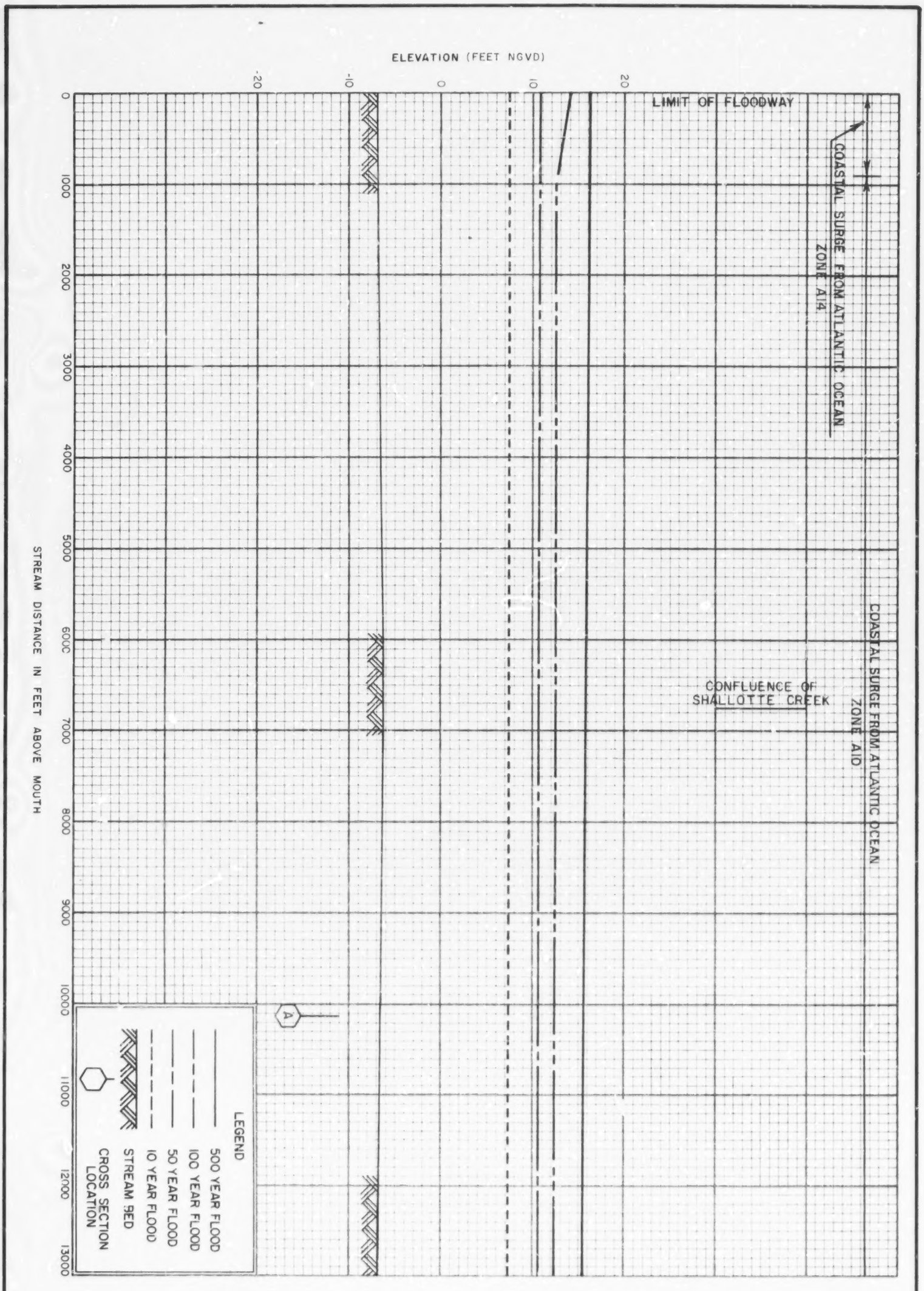

10P	FEDERAL EMERGENCY MANAGEMENT AGENCY BRUNSWICK COUNTY, N.C. (UNINCORPORATED AREA)	FLOOD PROFILES SHALLOTTE RIVER

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COASTAL SURGE FROM ATLANTIC OCEAN
ZONE AID

ELEVATION (FEET NGVD)

20
10
0
-10
-20

13000 14000 15000 16000 17000 18000 19000 20000 21000 22000 23000 24000 25000 26000

STREAM DISTANCE IN FEET ABOVE MOUTH

B C D

LEGEND
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

SHALLOTTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
BRUNSWICK COUNTY, N.C.
(UNINCORPORATED AREA)

11P

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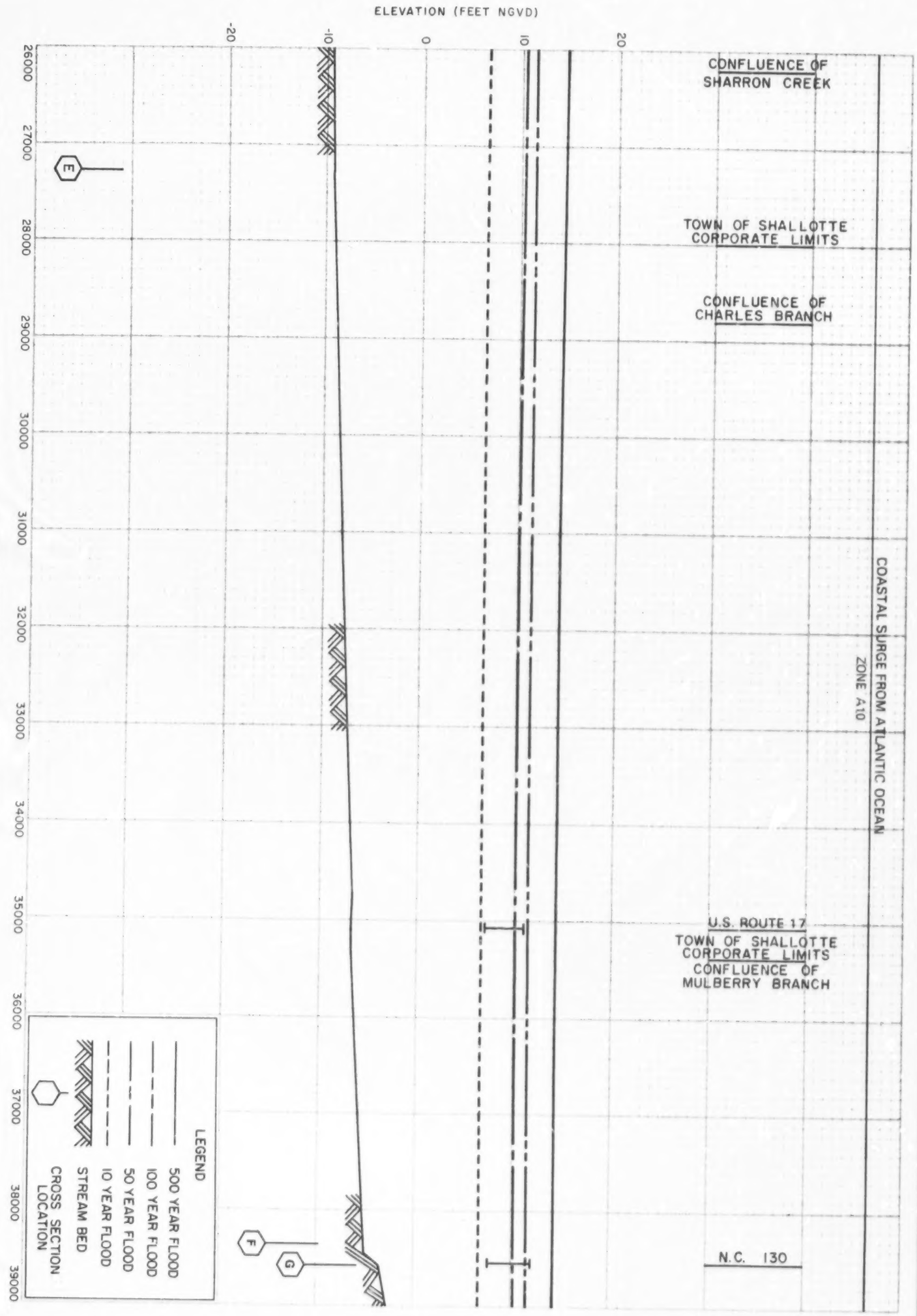

12P	FEDERAL EMERGENCY MANAGEMENT AGENCY BRUNSWICK COUNTY, N.C. (UNINCORPORATED AREA)	FLOOD PROFILES SHALLOTTE RIVER

52.

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FLOOD PROFILES

SHALLOTTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

13P

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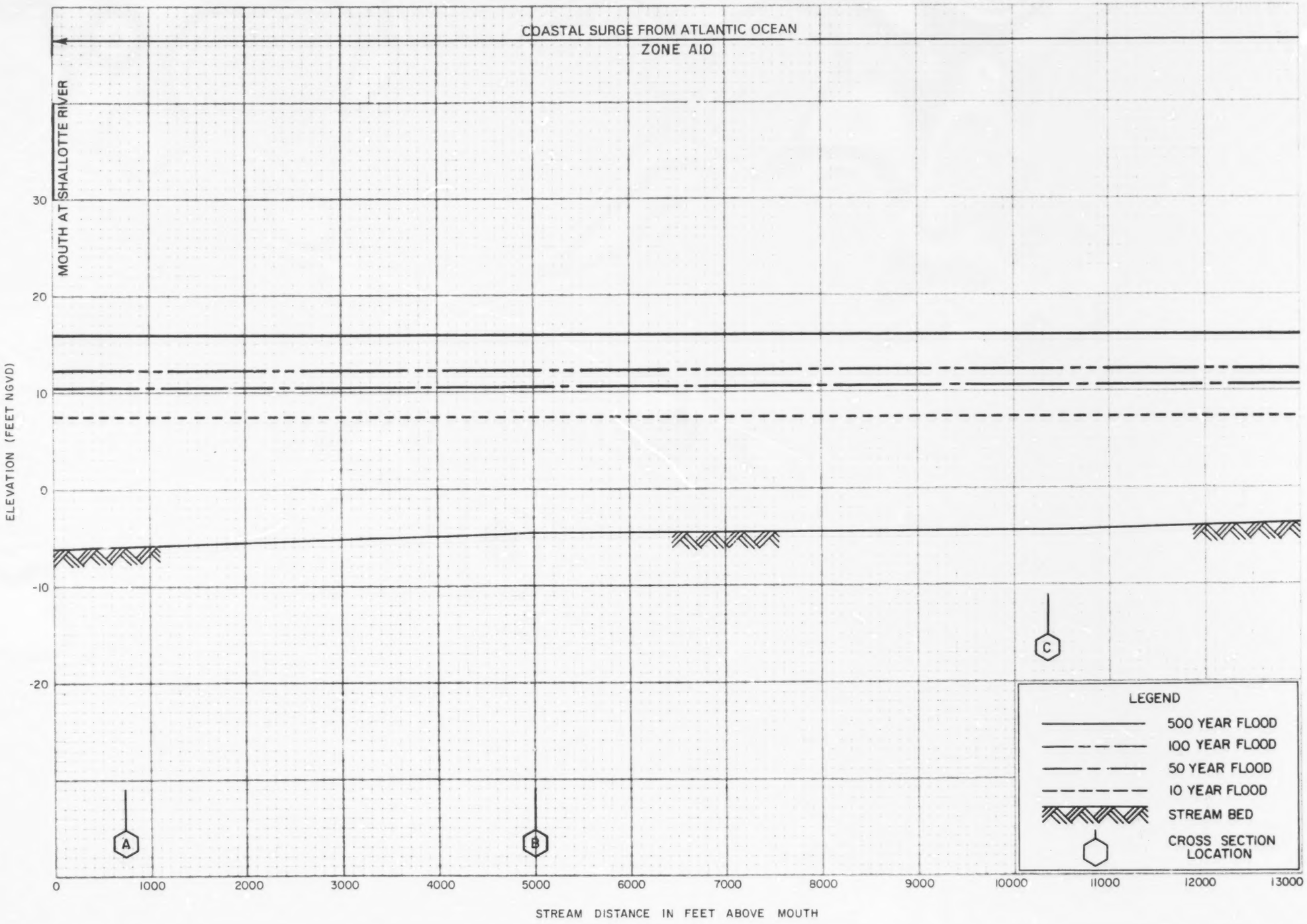

FLOOD PROFILES

SHALLOTTE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

14P

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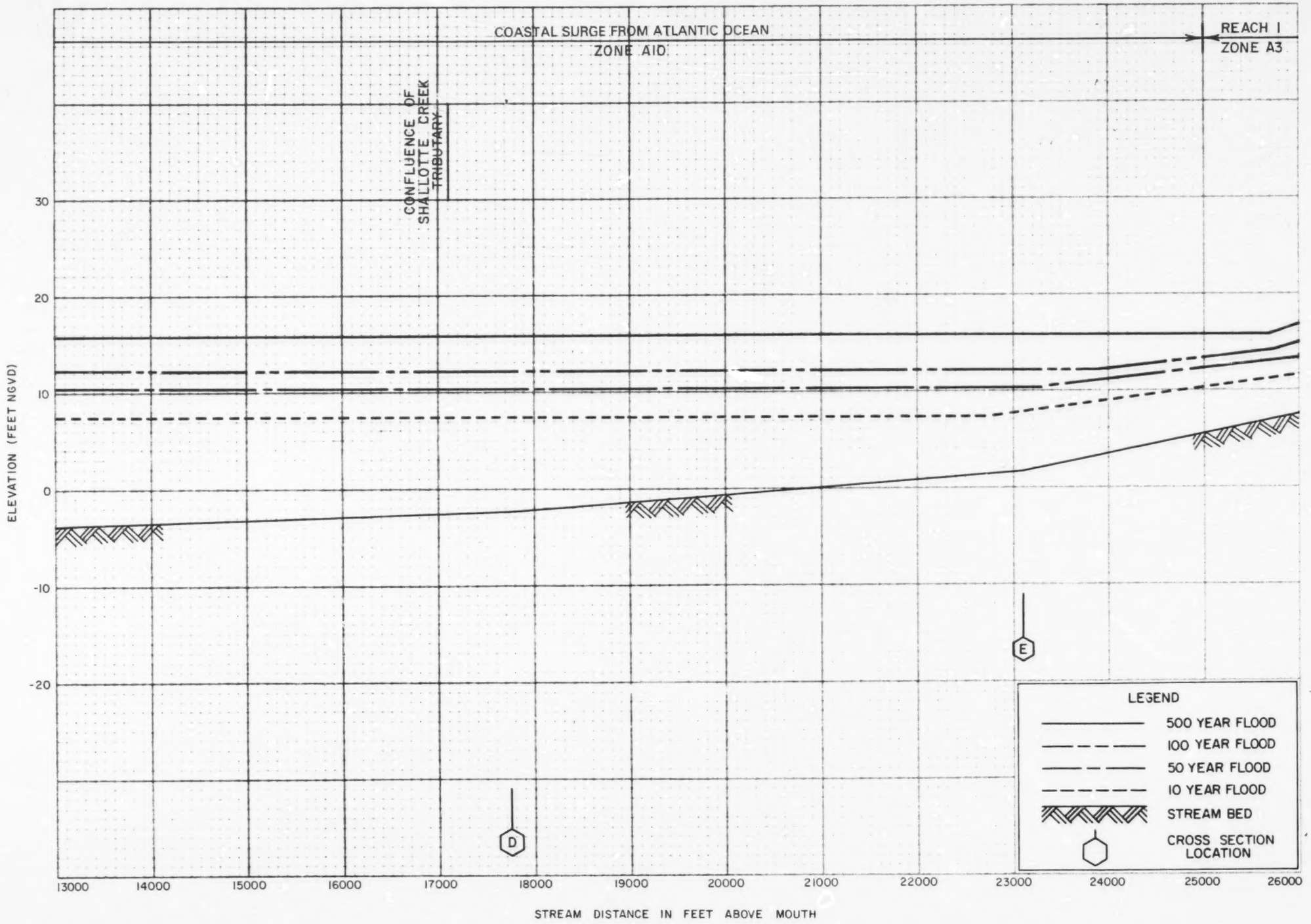

FLOOD PROFILES

SHALLOTTE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

15P

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REACH 1
ZONE A3

N.C. 130

LIMIT OF DETAILED STUDY

ELEVATION (FEET NGVD)

50
40
30
20
10
0

F G

H

26000 27000 28000 29000 30000 31000 32000 33000

STREAM DISTANCE IN FEET ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

SHALLOTTE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

16P

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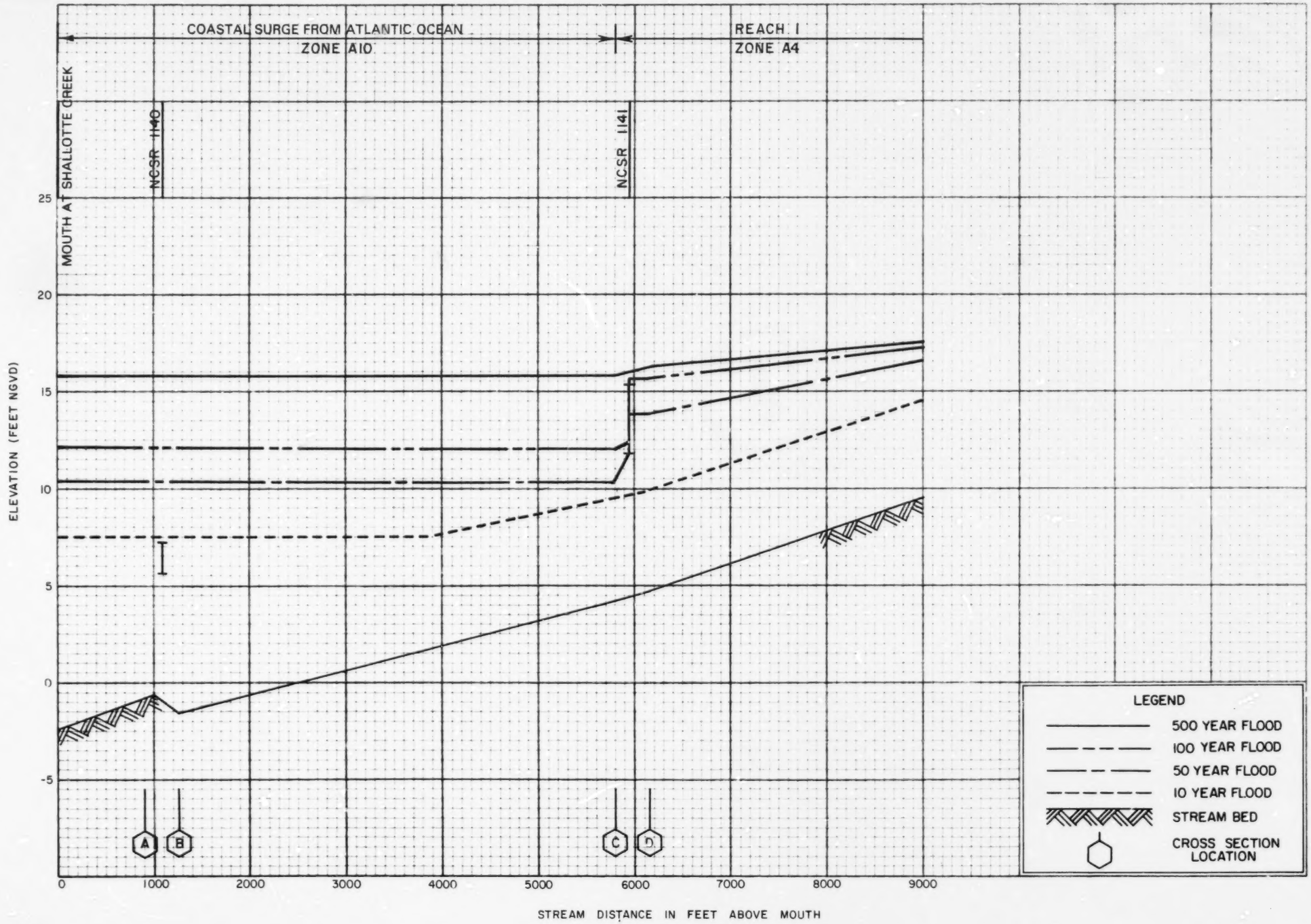

FLOOD PROFILES

SHALLOTTE CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

17P

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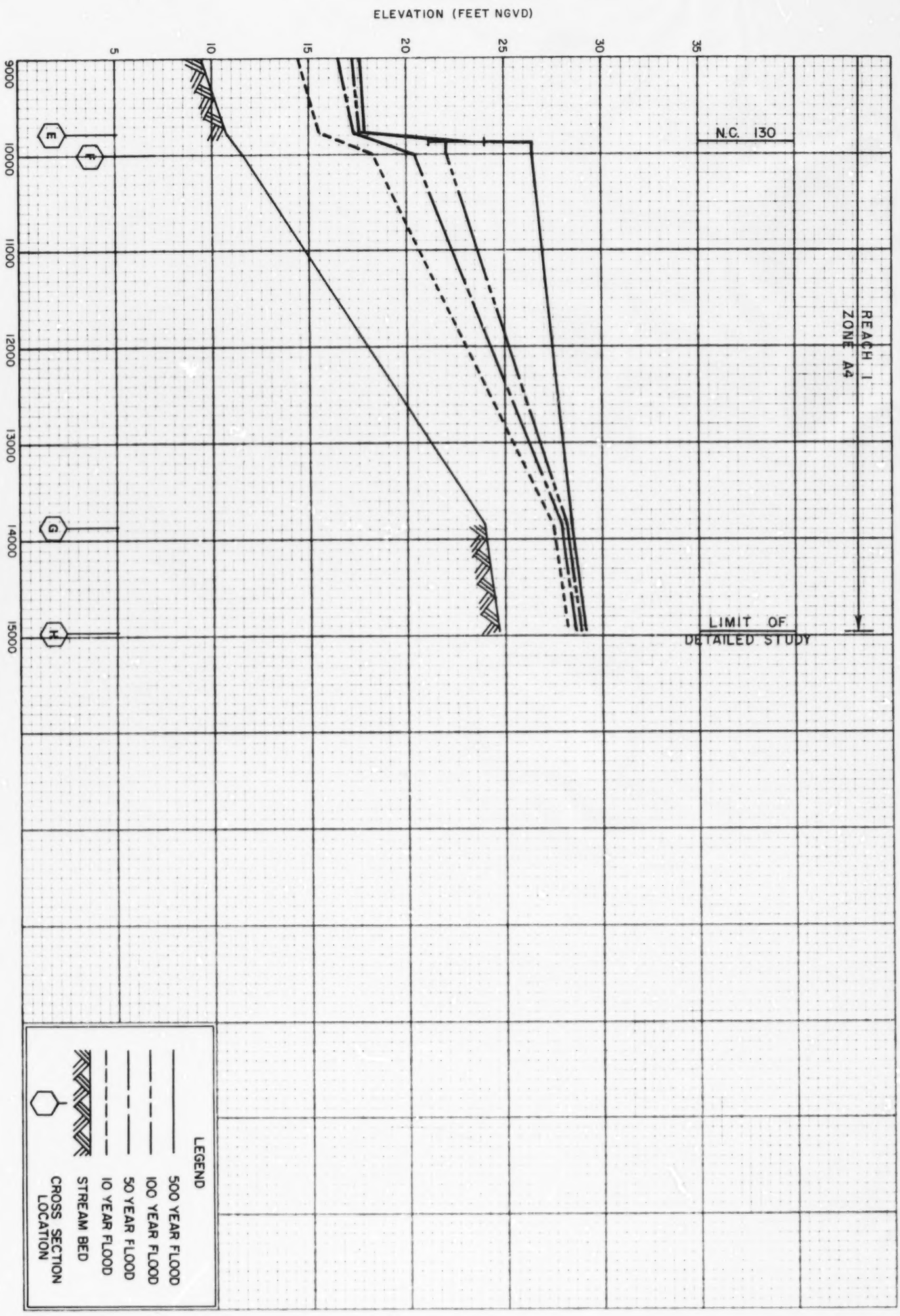

18P

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

FLOOD PROFILES

SHALLOTTE CREEK TRIBUTARY

58

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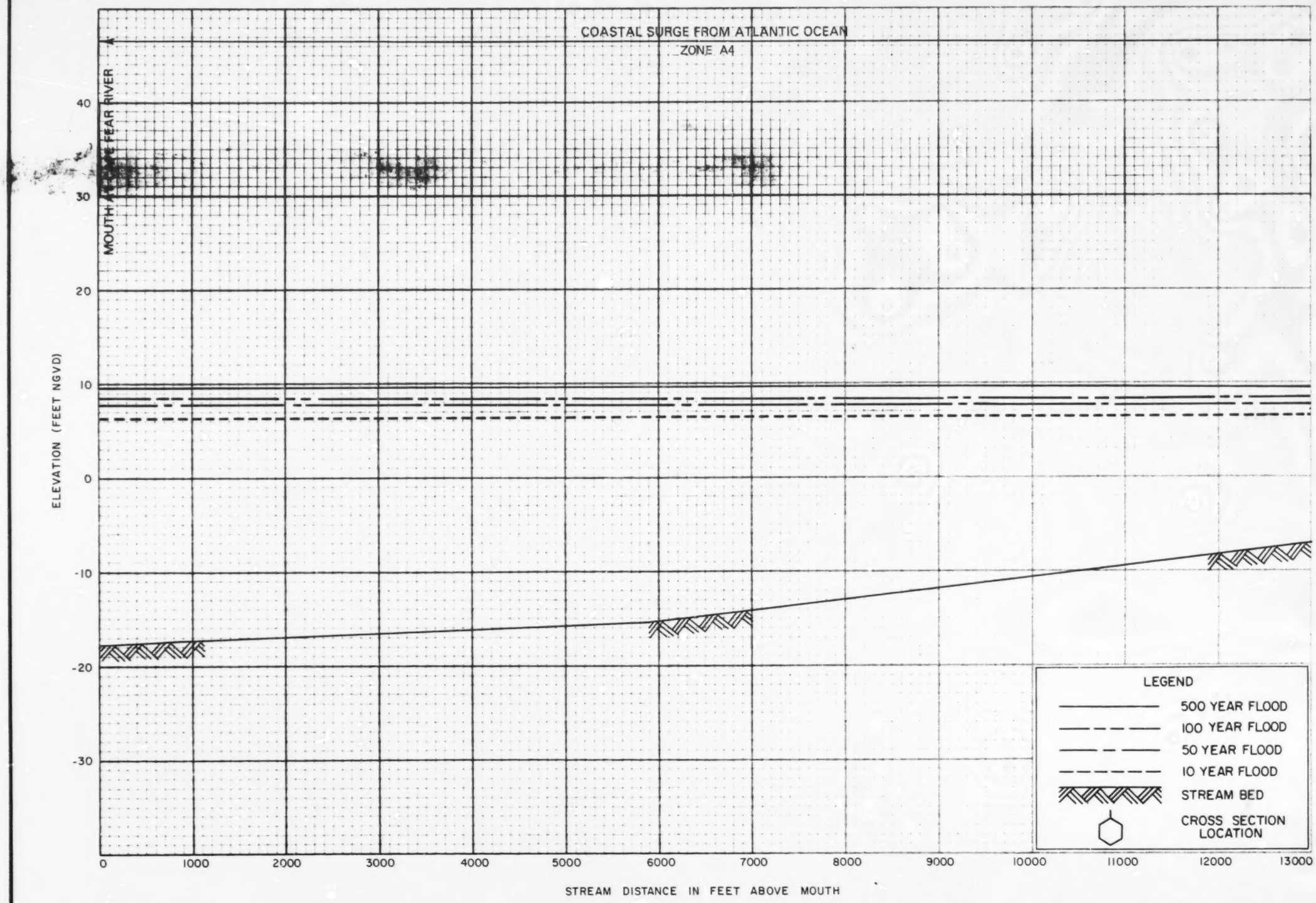

FLOOD PROFILES

INDIAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

19P

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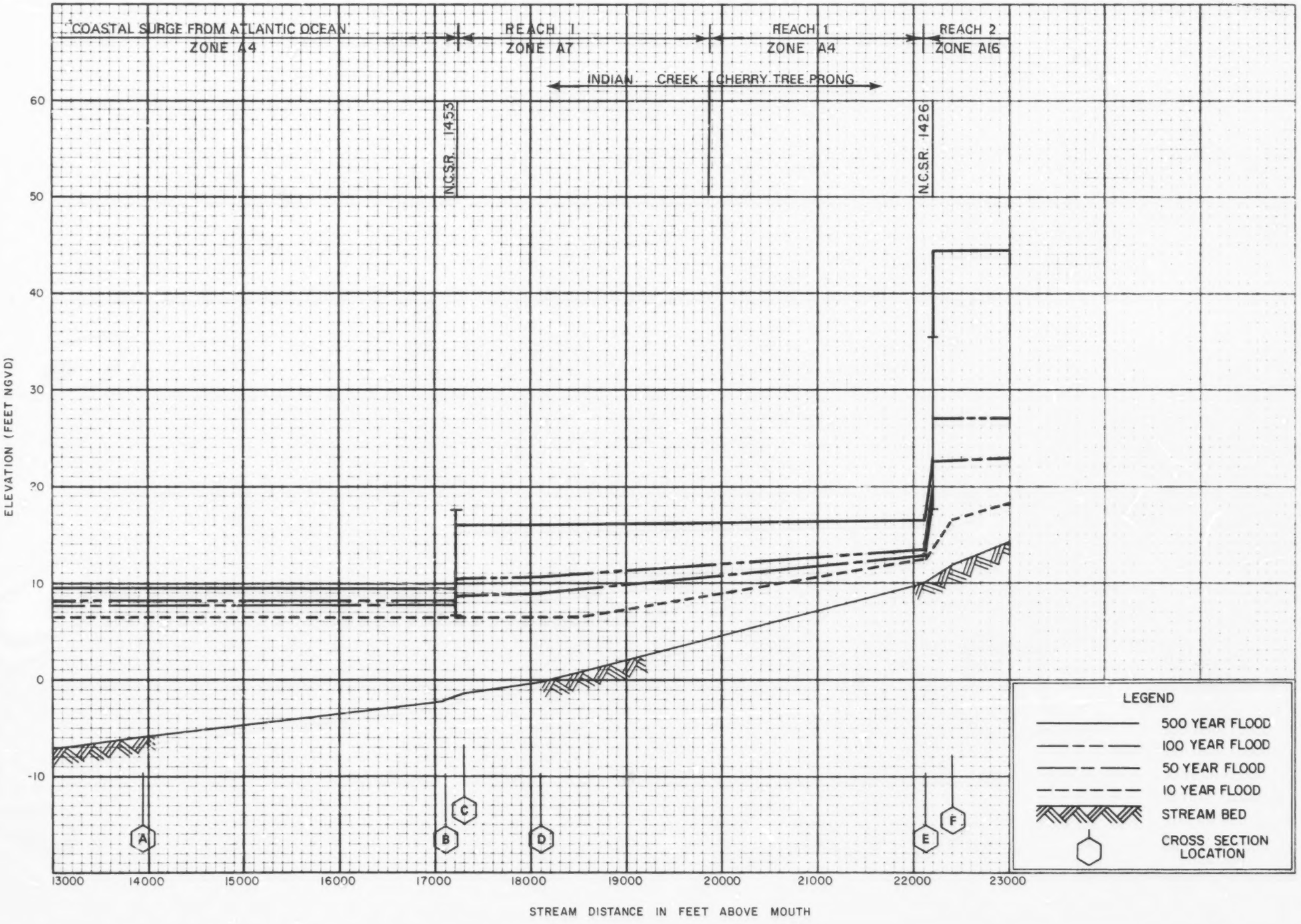

FLOOD PROFILES

INDIAN CREEK — CHERRY TREE PRONG

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.
(UNINCORPORATED AREA)

20P

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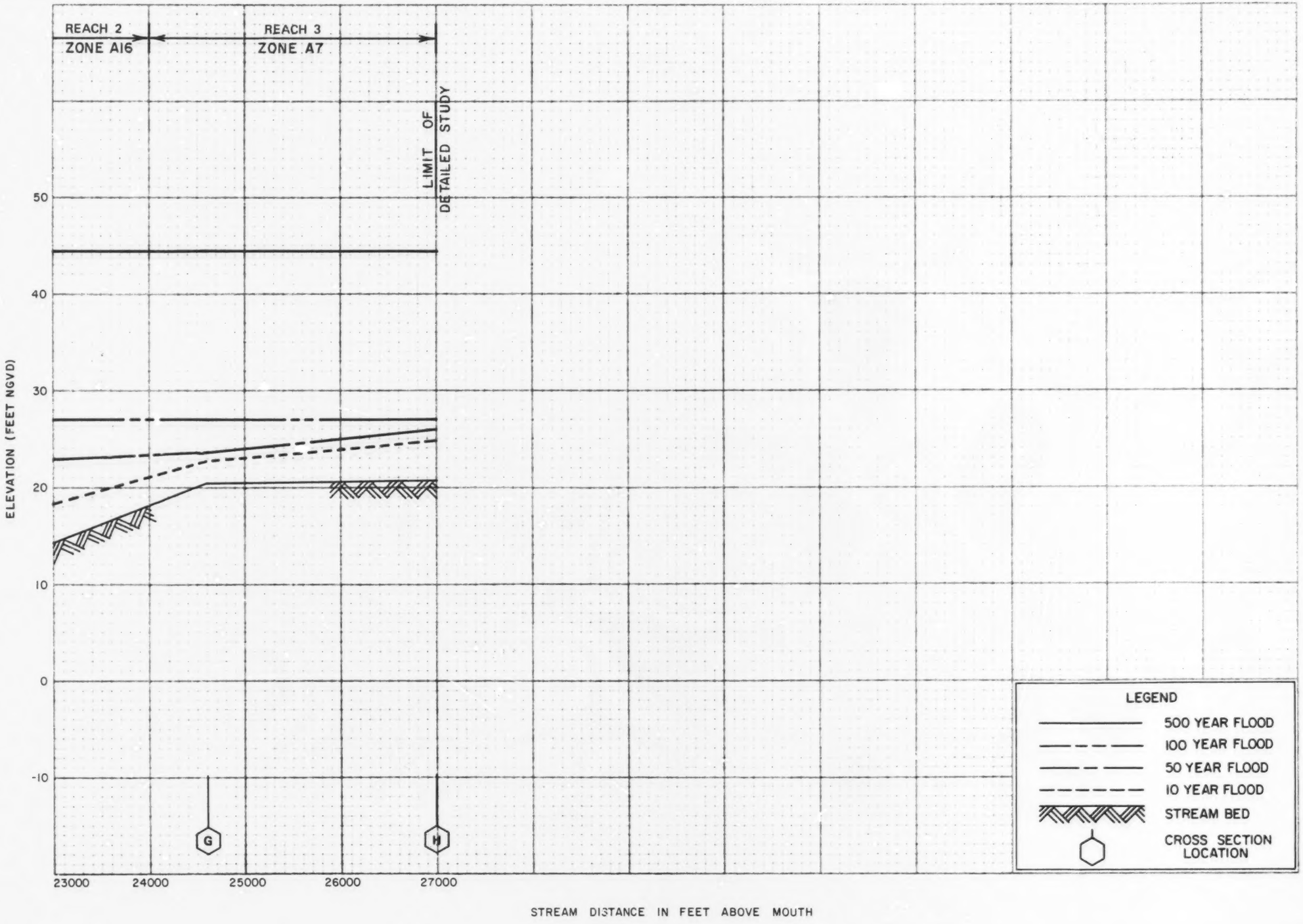

FLOOD PROFILES

CHERRY TREE PRONG

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

21P

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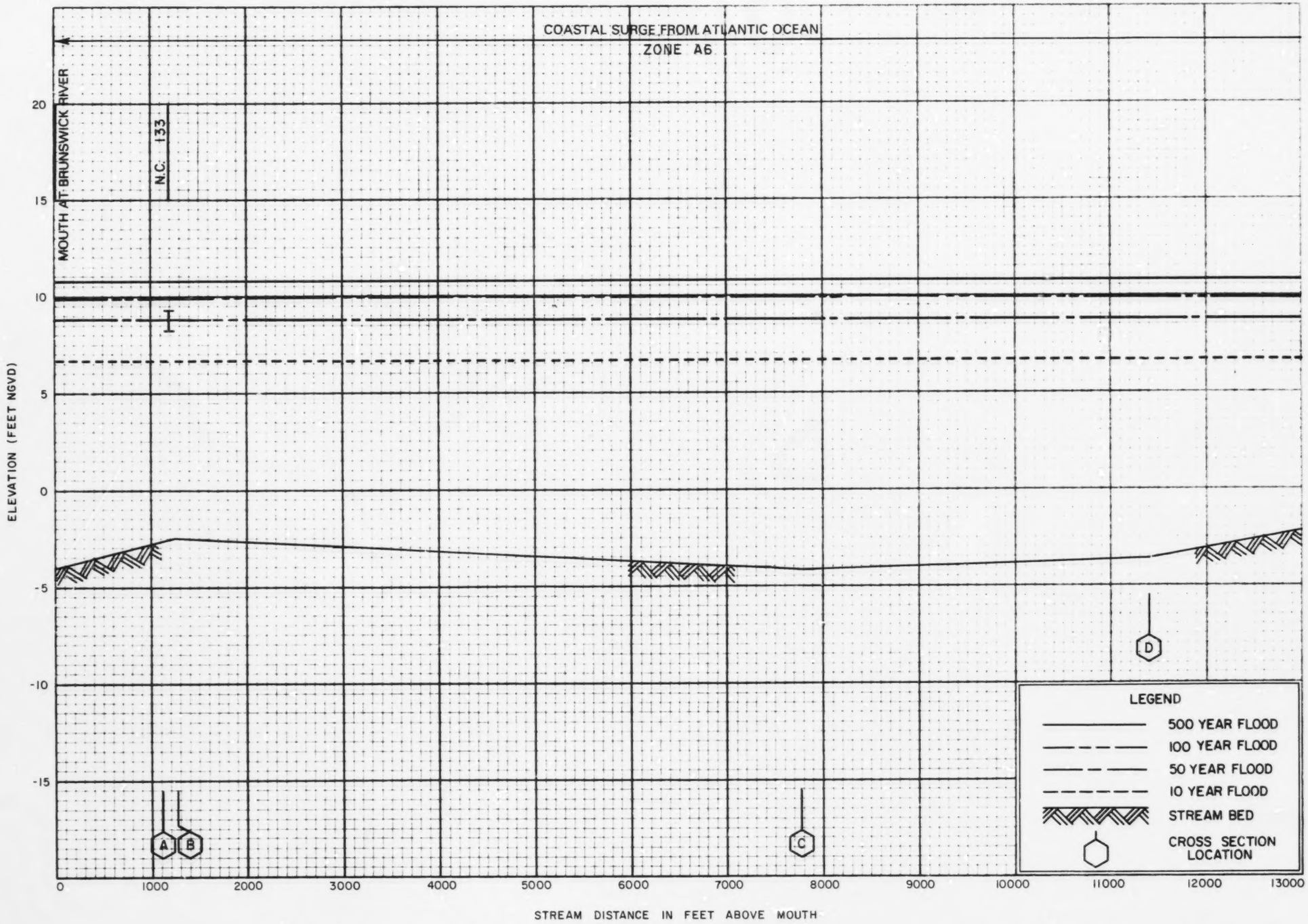

FLOOD PROFILES

JACKEYS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

22P

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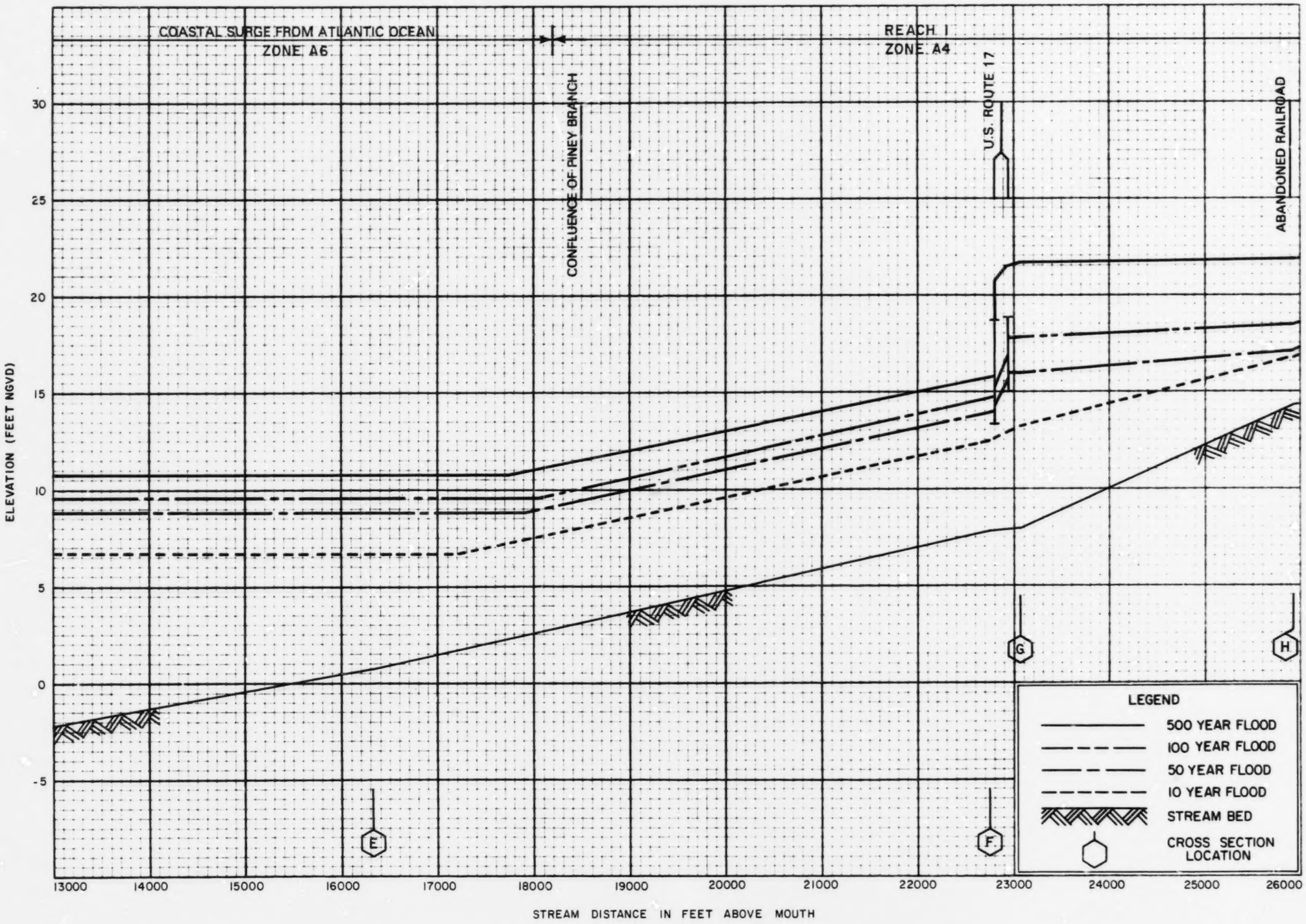

FLOOD PROFILES

JACKEYS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.
(UNINCORPORATED AREA)

23P

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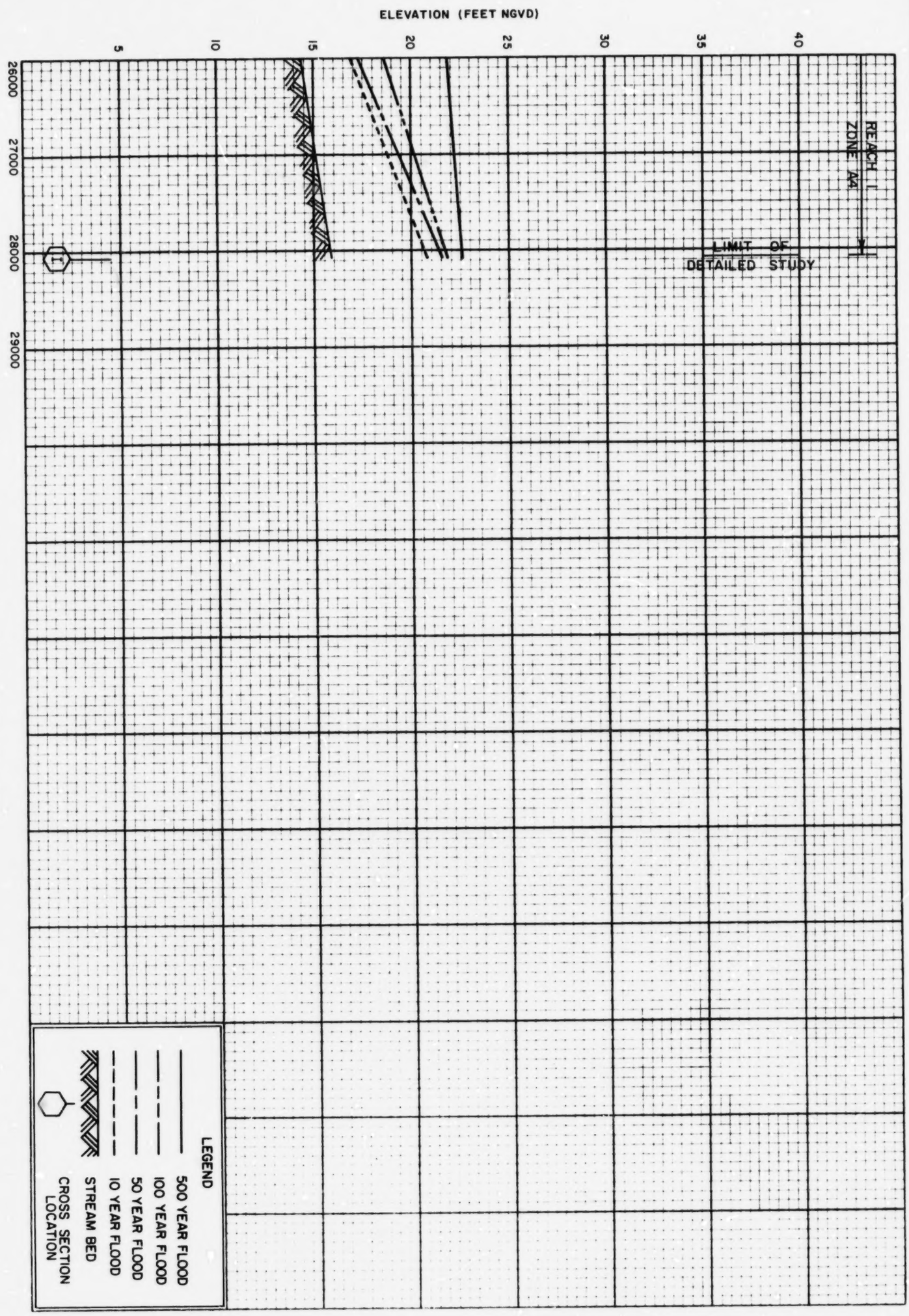

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

FLOOD PROFILES

JACKEYS CREEK

24P

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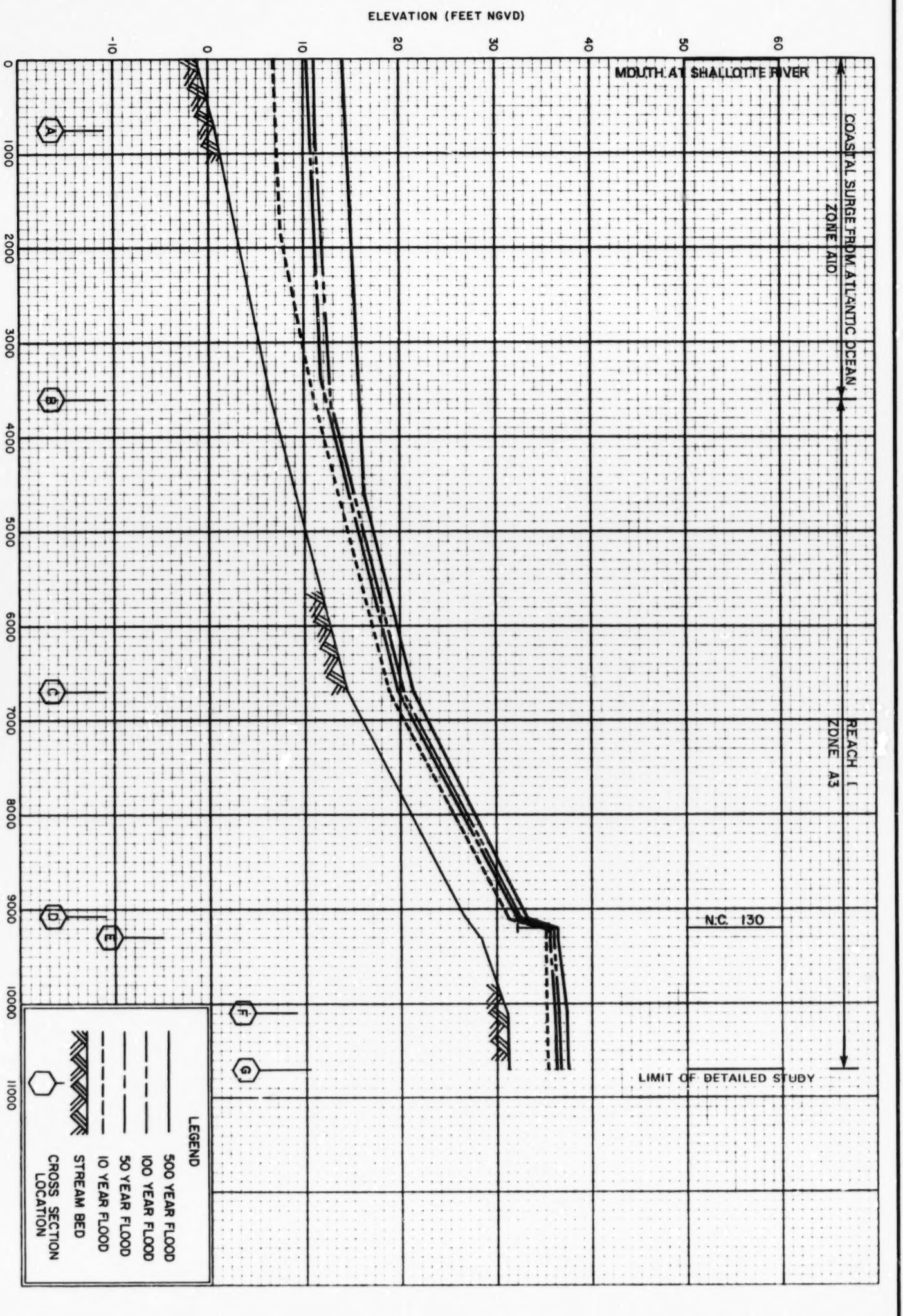

25P

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

FLOOD PROFILES

LOOKOUT CREEK

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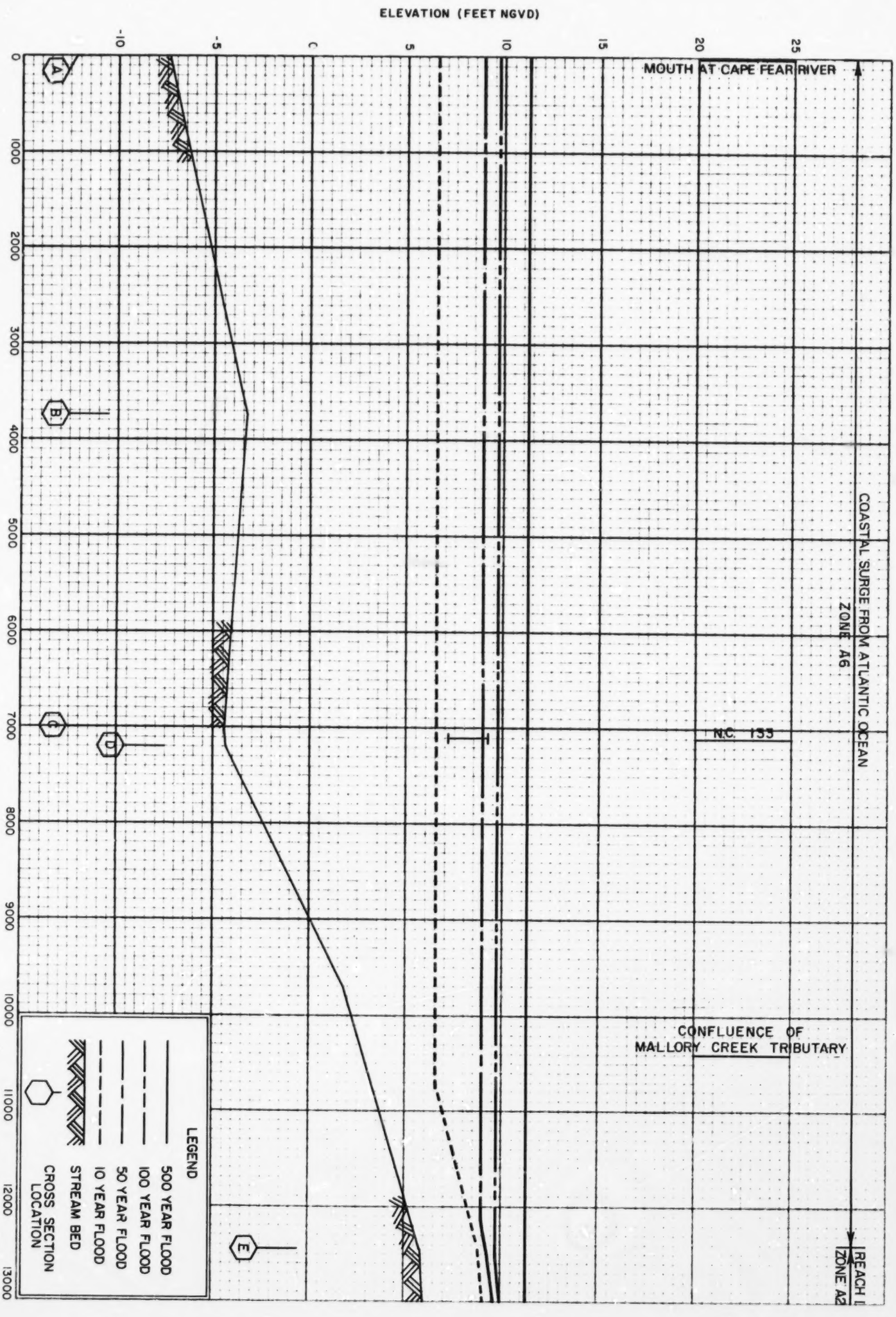

26P

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

FLOOD PROFILES

MALLORY CREEK

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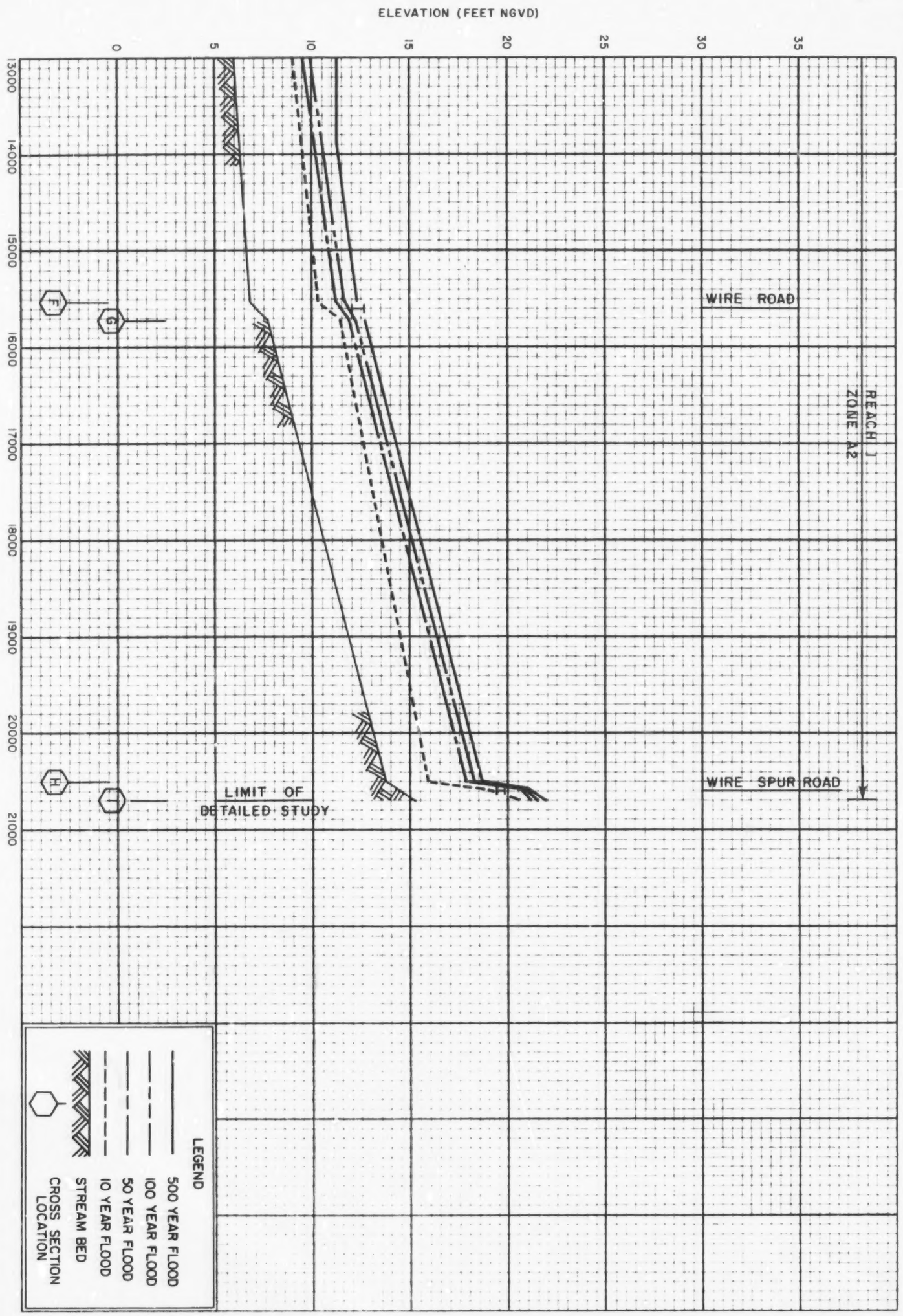

27P	FEDERAL EMERGENCY MANAGEMENT AGENCY BRUNSWICK COUNTY, N.C. (UNINCORPORATED AREA)	FLOOD PROFILES MALLORY CREEK

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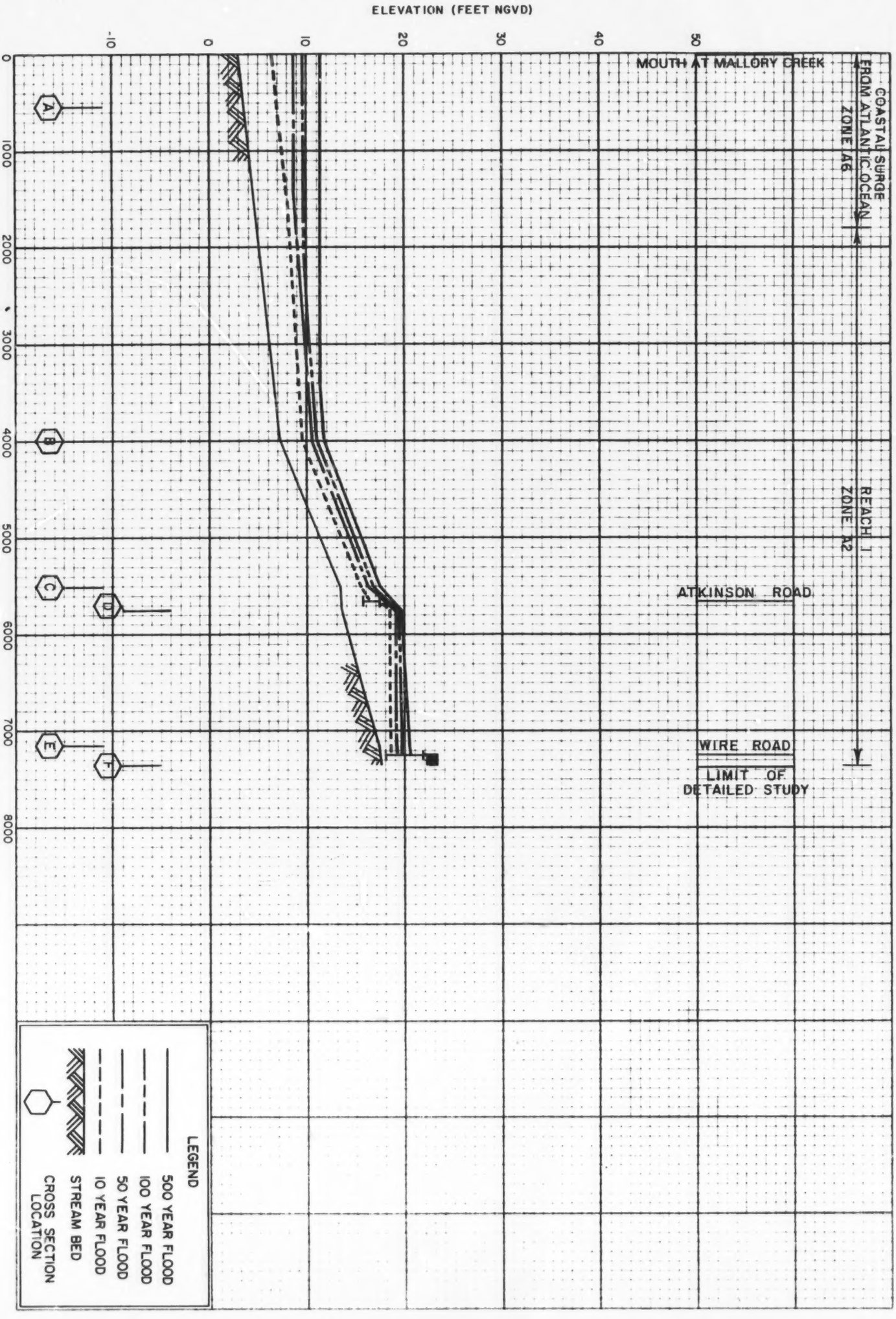

28P

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

FLOOD PROFILES

MALLORY CREEK TRIBUTARY

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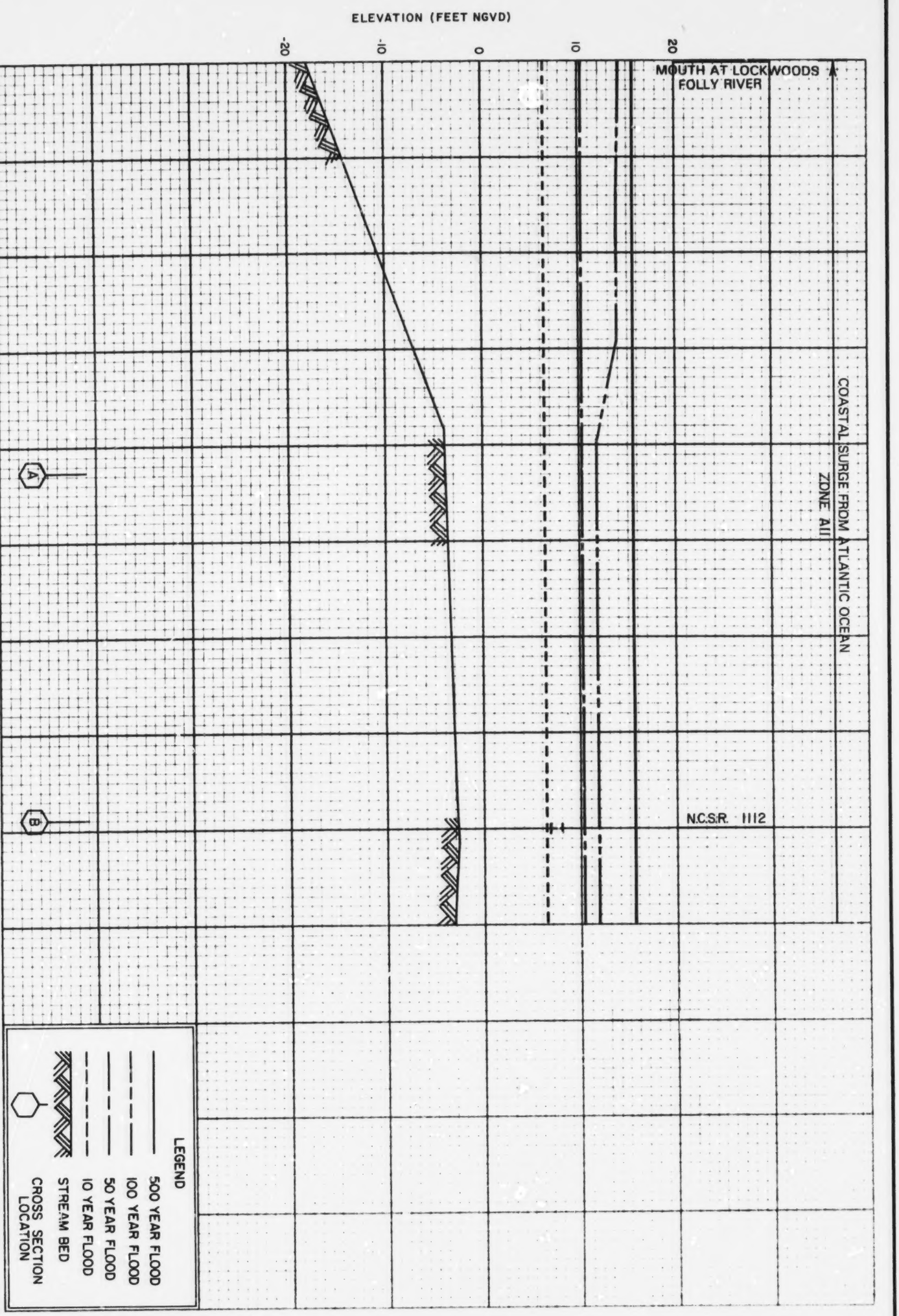

29P	FEDERAL EMERGENCY MANAGEMENT AGENCY BRUNSWICK COUNTY, N.C. (UNINCORPORATED AREA)	FLOOD PROFILES MILL CREEK

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COASTAL SURGE FROM ATLANTIC OCEAN
ZONE A11

LIMIT OF DETAILED STUDY

ELEVATION (FEET NGVD)

20
10
0
-10
-20

9000 10000 11000 12000 13000 14000

STREAM DISTANCE IN FEET ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.
(UNINCORPORATED AREA)

30P

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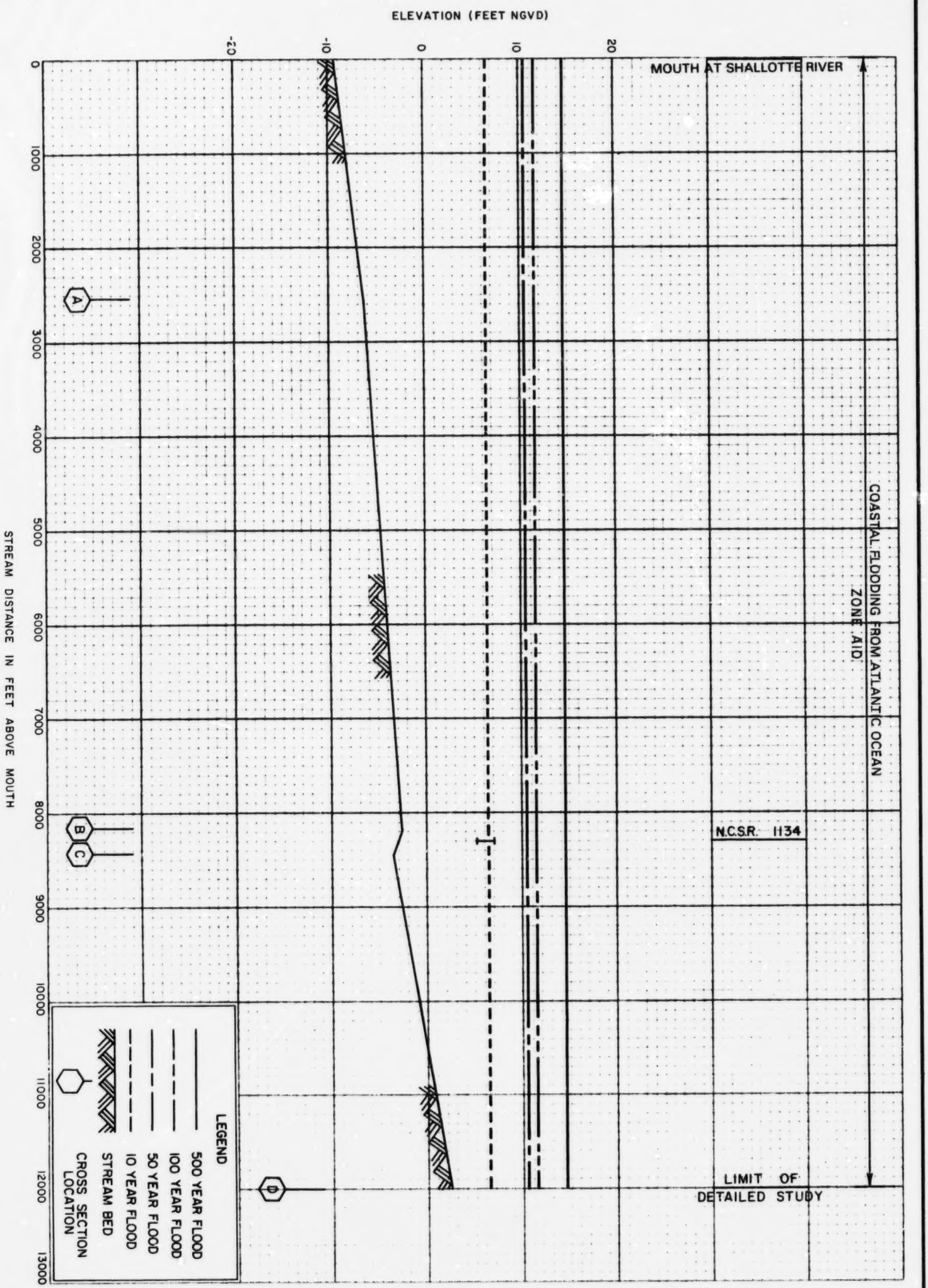

31P	FEDERAL EMERGENCY MANAGEMENT AGENCY BRUNSWICK COUNTY, N.C. (UNINCORPORATED AREA)	FLOOD PROFILES SHARRON CREEK

77

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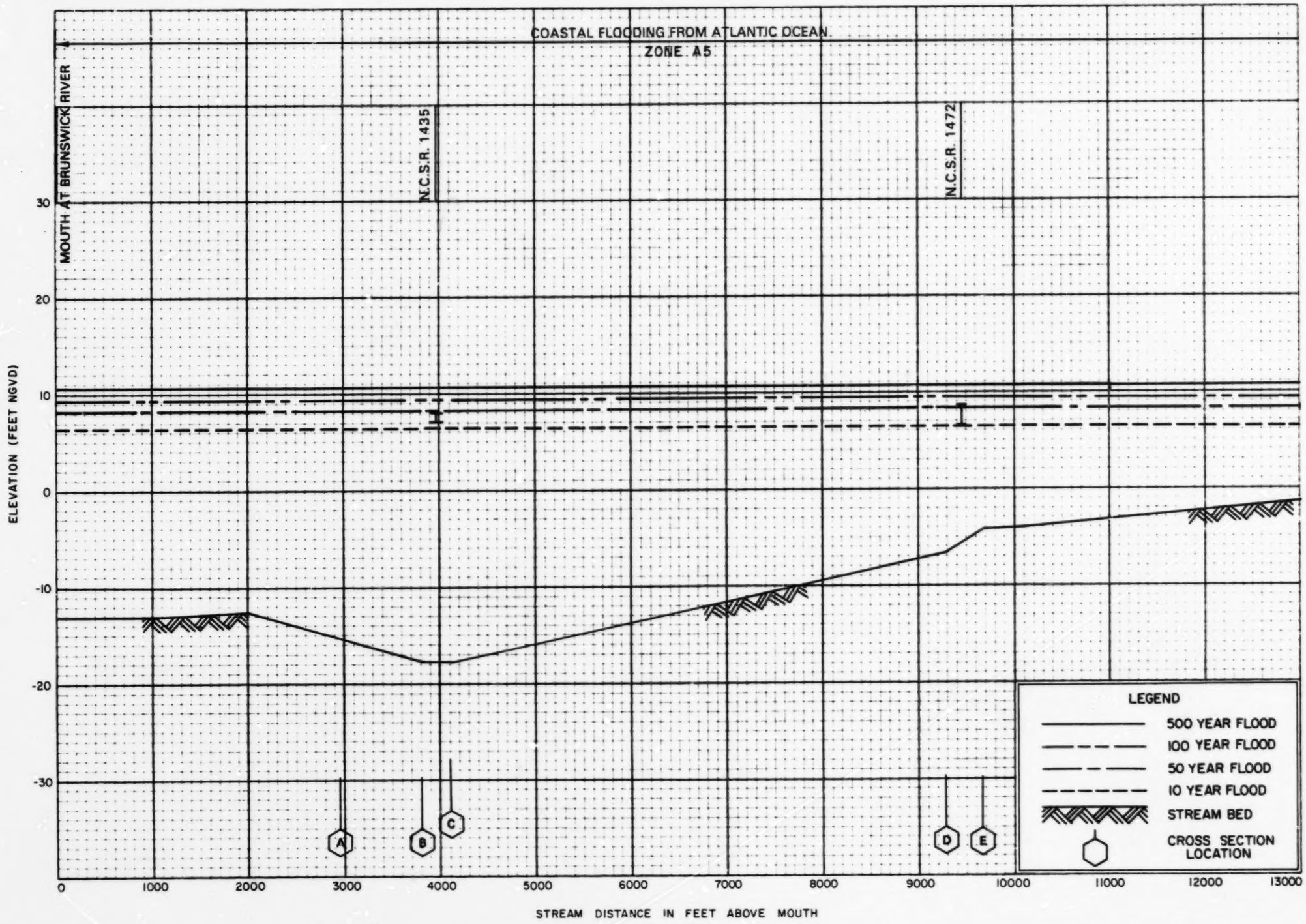

FLOOD PROFILES

STURGEON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
BRUNSWICK COUNTY, N.C.
(UNINCORPORATED AREA)

32P

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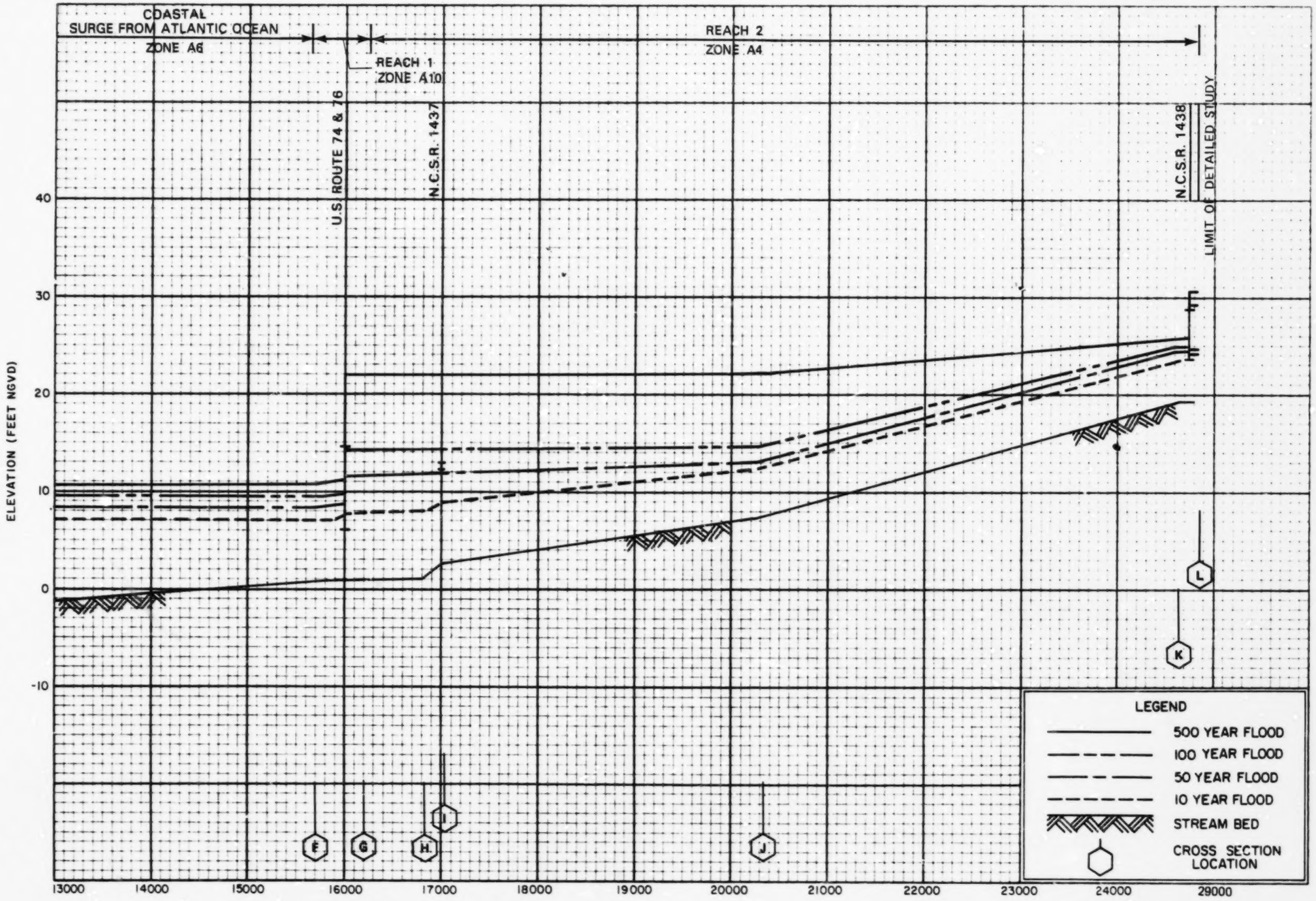


FLOOD PROFILES

STURGEON CREEK

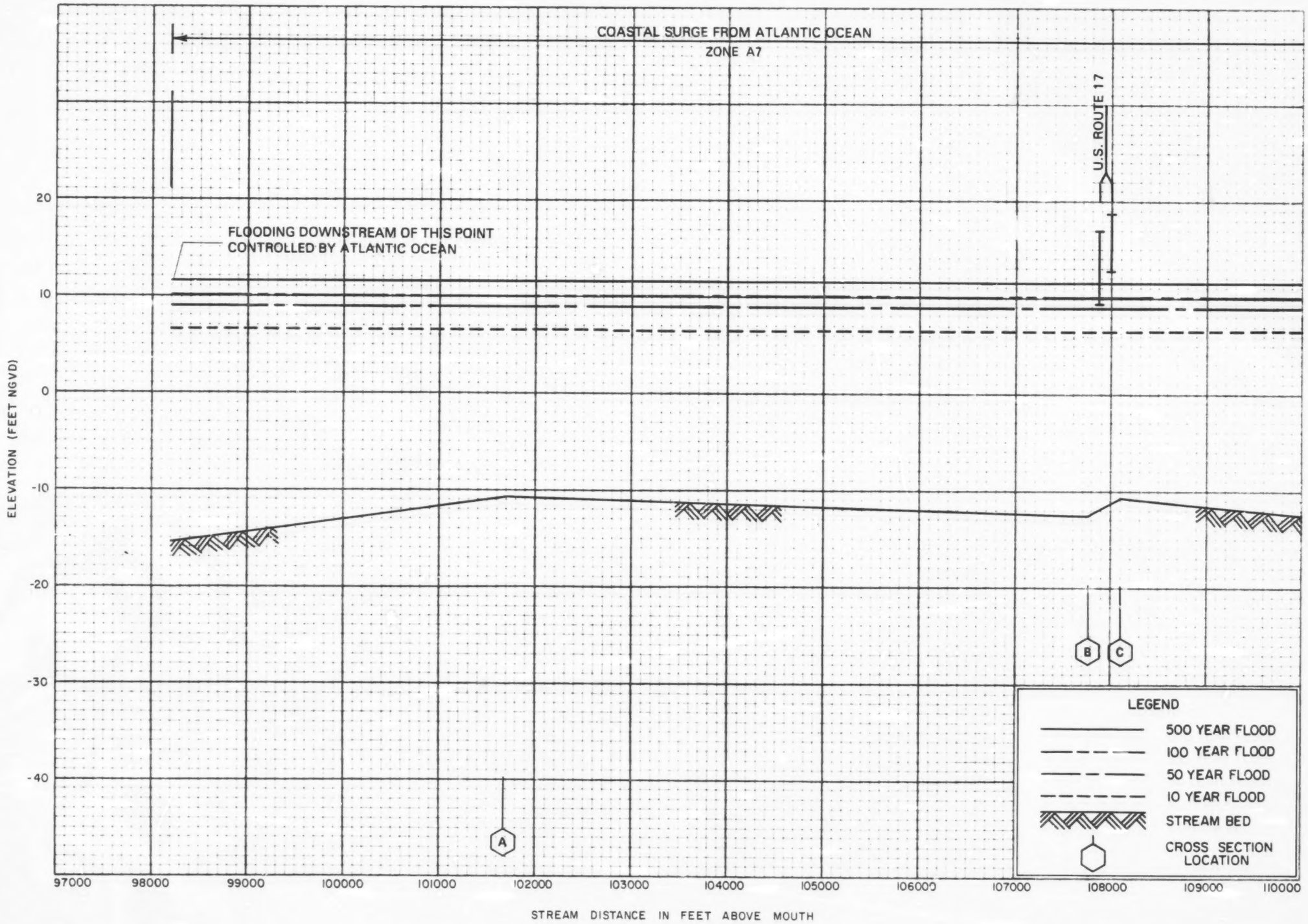
FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

33P

BEST COPY AVAILABLE



FLOOD PROFILES

TOWN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BRUNSWICK COUNTY, N.C.

(UNINCORPORATED AREA)

34P

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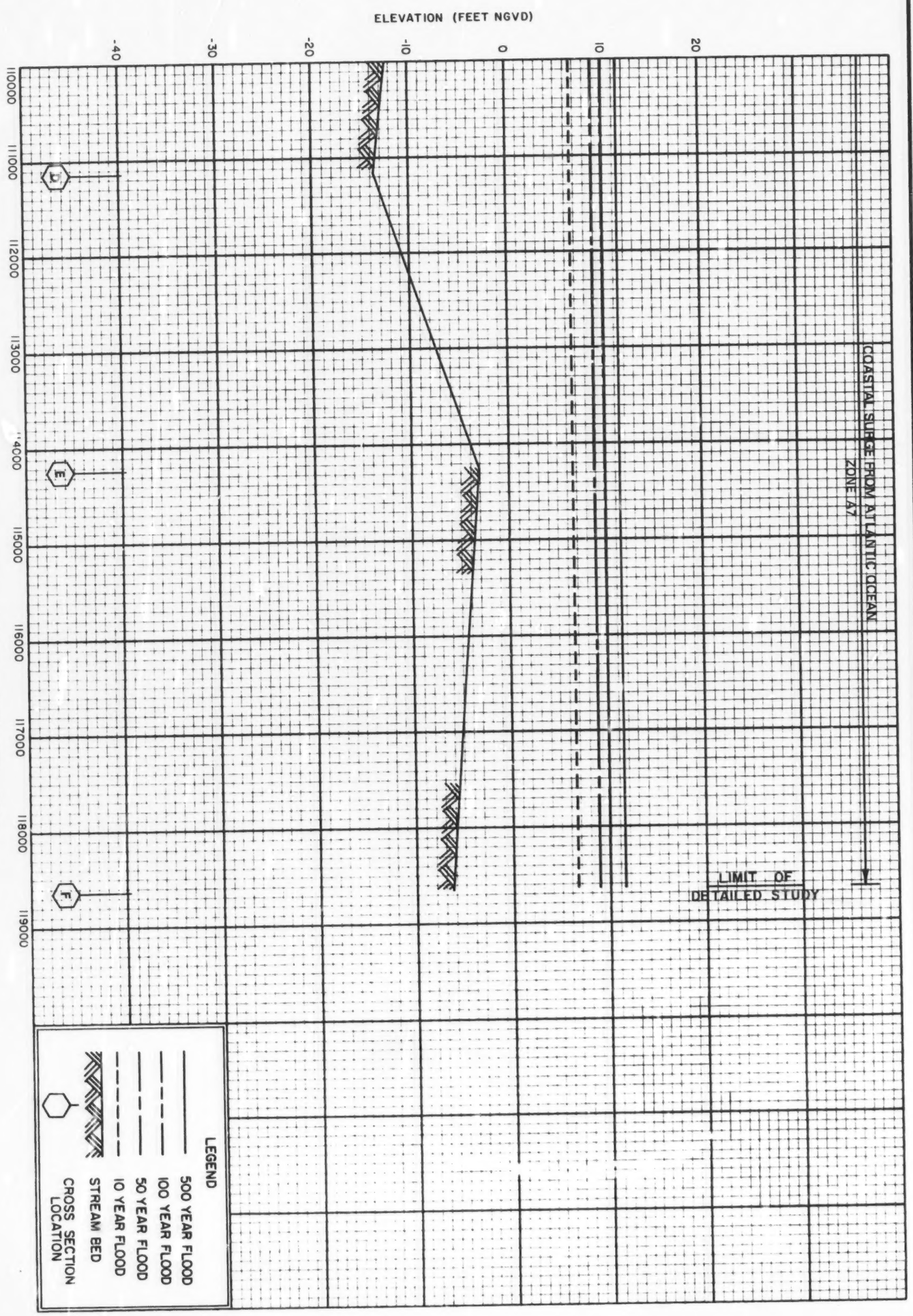

35P	FEDERAL EMERGENCY MANAGEMENT AGENCY BRUNSWICK COUNTY, N.C. (UNINCORPORATED AREA)	FLOOD PROFILES TOWN CREEK

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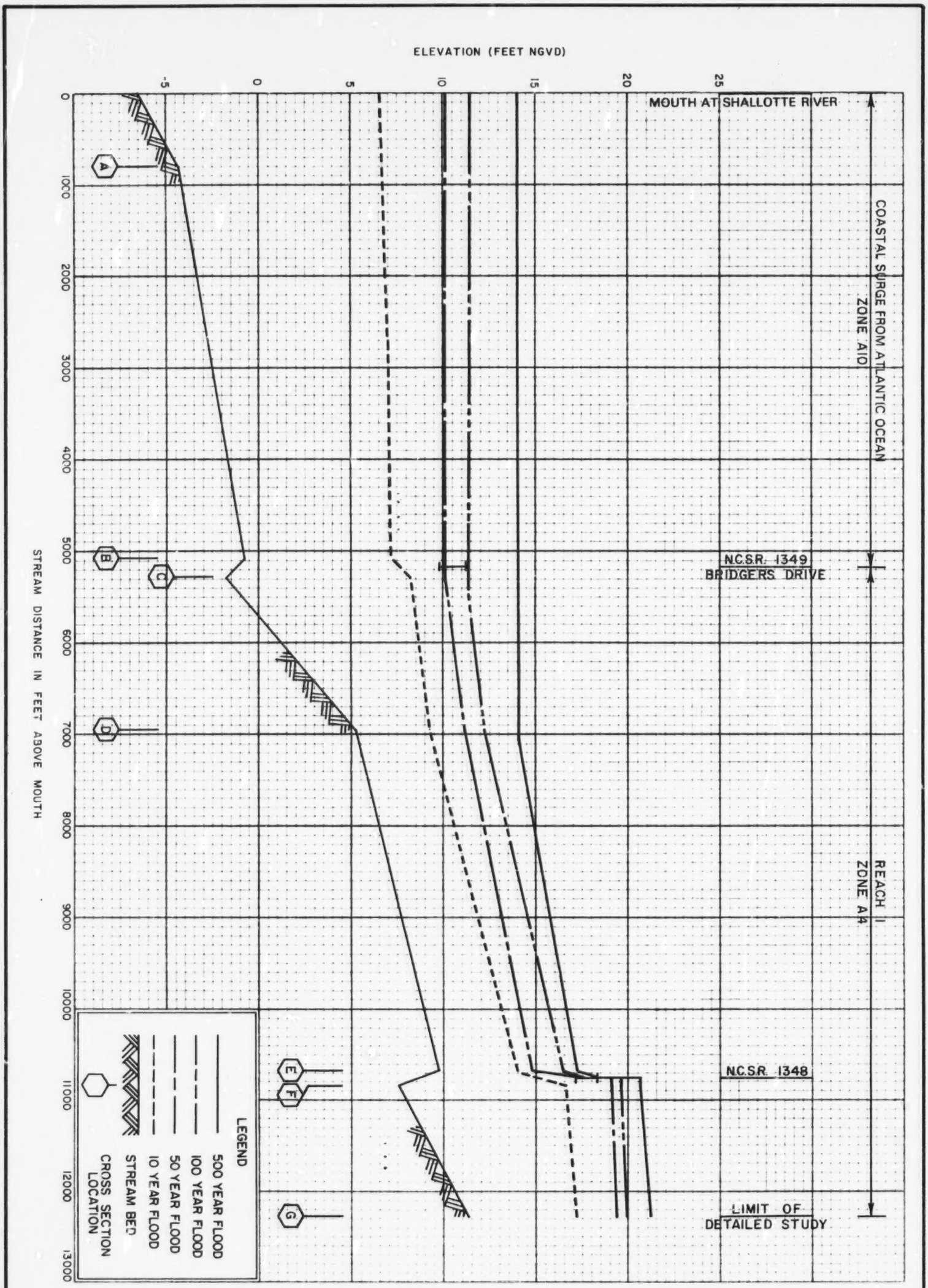

36P	FEDERAL EMERGENCY MANAGEMENT AGENCY BRUNSWICK COUNTY, N.C. (UNINCORPORATED AREA)	FLOOD PROFILES MULBERRY BRANCH

74

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